FIVE-YEAR REVIEW REPORT

Second Five-Year Review Report
for
Lindsay Manufacturing Superfund Site

Lindsay, Nebraska

July 2003

Prepared by:

U.S. Environmental Protection Agency
Region 7
Kansas City, Kansas

Approved by:

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7/3/03
(Date)

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List of Acronyms

AOIW	Add On Interceptor Well
ARAR	Applicable or Relevant and Appropriate Requirement
CD	Consent Decree
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986
CFR	Code of Federal Regulations
CWA	Clean Water Act
1,1-DCE	1,1-Dichloroethylene
EPA	United States Environmental Protection Agency
HRC®	Hydrogen Release Compound
MCL	Maximum Contaminant Level
MOMP	Monitoring Operation and Maintenance Plan
MW	Monitoring Well
NCP	National Contingency Plan
NDEQ	Nebraska Department of Environmental Quality
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
OIW	Original Interceptor Well
O&M	Operation and Maintenance
OMP	Operation and Maintenance Plan
OU	Operable Unit
PCE	Tetrachloroethylene
PRP	Potentially Responsible Party
RA	Remedial Action

RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager
SVE	Soil Vapor Extraction
1,1,1-TCA	1,1,1-Trichloroethane
TIW	Third Interceptor Well
VOC	Volatile Organic Compounds
WasteLan	EPA's database of Superfund Sites

EXECUTIVE SUMMARY

The remedy for the Lindsay Manufacturing Superfund Site in Lindsay, Nebraska, included a soil vapor extraction pilot, a full scale soil vapor extraction system, ground water extraction and treatment, ground water irrigation pilot system, remediation alternative, injection of hydrogen release compound (HRC®) and ground water monitoring. The site achieved construction completion with the signing of the Preliminary Close-Out Report on August 2, 1995. The trigger for this Five-Year Review was the signature date for the first Five-Year Review report on July 1, 1998.

The assessment of the Five-Year Review found that the remedy was constructed in accordance with the requirements of the Record of Decision (ROD). The remedy is currently functioning as designed. The immediate threats to human health and the environment have been addressed and the remedy remains protective. However, additional steps will be implemented to address the ground water plume that has migrated beyond the capture of the existing irrigation wells and to verify that no other domestic supplies are affected by this plume.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name *(from WasteLAN)*: Lindsay Manufacturing Superfund Site		
EPA ID *(from WasteLAN)*: NED068645696		
Region: 7	**State:** NE	**City/County:** Lindsay/Platte
SITE STATUS		
NPL status: ☒ Final ☐ Deleted ☐ Other (specify)		
Remediation status (choose all that apply): ☐ Under Construction ☐ Operating ☒ Complete		
Multiple OUs?* X YES ☐ NO	**Construction completion date:** 8 / 3 / 1995	
Has site been put into reuse? X YES ☐ NO		
REVIEW STATUS		
Lead agency: ☒ EPA ☐ State ☐ Tribe ☐ Other Federal Agency		
Author name: Diane Easley		
Author title: Remedial Project Manager	**Author affiliation:** U.S. EPA, Region 7	
Review period:** 7 / 1 / 1998 to 7 / 1 / 2003		
Date(s) of site inspection: 2 /12 / 2003		
Type of review:	☒ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead ☐ Regional Discretion)	
Review number: ☐ 1 (first) **2 (second)** ☐ 3 (third) ☐ Other (specify)		
Triggering action: ☐ Actual RA On-Site Construction ☐ Construction Completion ☐ Other (specify)	☐ Actual RA Start at OU# NA x **Previous Five-Year Review Report**	
Triggering action date *(from WasteLAN)*: 7 / 1 / 1998		
Due date *(five years after triggering action date)*: 7 / 1 / 2003		

* ["OU" refers to operable unit.]

** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form - Additional Information

Issues: The ground water plume migrating from the plant site has impacted two domestic supply (Beller's and Priester's) wells with1,1-dichloroethene, 1,1,1-trichloroethane and tetrachloroethylene. Beller's stock well recently showed some detections of the same three contaminants. Lindsay has been working with these owners to treat the water at the well head. Monitoring of the domestic supplies continue. In February 2003, concern was expressed to Environmental Protection Agency (EPA) regarding the possibility that the plume had impacted other domestic supply wells. Lindsay and EPA sampled several wells and determined that no contamination was present above the maximum contaminant levels (MCLs) in the supplies tested. See Figure 2 that shows the locations of the domestic, stock and irrigation wells tested.

Recommendations and Follow-Up Actions: Lindsay is working to identify the location of this plume and will work with EPA and Nebraska Department of Environmental Quality (NDEQ) to address this contamination. Lindsay will present to EPA an investigation plan and/or installation plan to identify the plume and to identify alternatives to address the plume. No current ongoing exposure to contaminated ground water is known to be occurring as the owners of the impacted domestic supply wells are being provided alternative water supply/treated water. Lindsay is also working with the owners to install whole house treatment systems at each location.

Protectiveness Statement(s): The remedy at the site, in its present state, is protective of human health and the environment in the short-term. In the long-term, steps will be implemented to ensure that the plume is contained and further migration has been halted. Site contamination has been addressed to date through the use of soil vapor extraction and ground water extraction and treatment. Lindsay also performed an action to address the residuum in the aquifer through the use of hydrogen release compound. The information gained from this additional work indicate that the levels of chlorinated solvents remaining in the aquifer are partially contained through the use of pumping for irrigation purposes. The extent of ground water contamination migrating from the facility will be determined and Lindsay will identify alternatives to address this plume. Lindsay is providing drinking water and whole house treatment for the owners of two domestic supplies that are contaminated. Monitoring of the ground water and domestic water supplies continue.

Long-Term Protectiveness: Long-term protectiveness of the remedial action will be verified by continuing inspections, maintenance, and sampling of ground water at the site, as specified in the Monitoring Operation and Maintenance Plan (MOMP). Current data indicate limited impacts to ground water from the manufacturing facility as shown in Figure 4. The impacted domestic supplies are being monitored and treated or offered treatment by Lindsay. Future work will include identifying the extent of the contamination as the plume has migrated beyond its former boundary.

Other Comments: Lindsay will identify all remaining ground water areas affected by their contamination and present alternatives to address this contamination. The EPA and NDEQ will work with Lindsay to ensure that the migration of the plume is halted and addressed.

LINDSAY MANUFACTURING SUPERFUND SITE
LINDSAY, NEBRASKA
SECOND FIVE-YEAR REVIEW REPORT

I. INTRODUCTION

The purpose of the Five-Year Review is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in Five-Year Review reports. In addition, Five-Year Review reports identify issues found during the review, if any, and identify recommendations to address them.

The Agency is preparing this Five-Year Review report pursuant to Section 121 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments Reauthorization Act of 1986 (CERCLA) and the National Contingency Plan (NCP). CERCLA Section 121(c) states:

> *If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with Section 104 or 106, the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.*

The Agency interpreted this requirement further in the NCP; 40 CFR 300.430(f)(4)(ii) states:

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

The EPA, Region 7, conducted the second Five-Year Review of the remedy implemented at the Lindsay Manufacturing Superfund Site in Lindsay, Nebraska. This review was conducted by the Remedial Project Manager (RPM) for the entire site from January 2003 through June 2003. This report documents the results of the review.

This is the second Five-Year Review for the Lindsay Manufacturing Superfund Site. The triggering action for this statutory review is the signature date for the first Five-Year Review which was July 1, 1998. The second Five-Year Review is required due to the fact that hazardous

substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure.

II. SITE CHRONOLOGY

The following table presents the site chronology. More details on the remediation events shown on the table are presented in Section III.

Table 1 - Chronology of Site Events

Event	Date
Paul Zimmer starts a sprinkler irrigation business that would later become Lindsay Manufacturing Company	1958
Plant constructed and Lindsay Manufacturing begins	1961-1969
Incorporated and expanded	1971-1972
DeKalb Agrasearch Inc. acquires Lindsay	1974
Lindsay drills 4 test holes and a deep test hole. Proposed water treatment facility, acidic ground water and elevated temperatures. New public water supply installed	1983
OIW well installed, Lindsay proposed for National Priorities List (NPL)	1984
AOIW installed	1988
Lindsay begins Remedial Investigation/Feasibility Study (RI/FS)	1988
NPL Final	1989
Proposed Plan to Public	1990
Record of Decision (ROD)	1990
Consent Decree Signed, Remedial Design Approved for TIW	1992
TIW installed, date that triggered the first Five-Year Review	1992
Design for soil vapor extraction (SVE) system approved. Remedial Action Work Plan Approved	1994
Inspection of SVE system	1995
Established SVE clean up criteria. Incorporated irrigation as part of the ground water treatment system, new risk assessment by state	1996

Event	Date
Determined that both Area 1 and Area 2 for SVE were approaching cleanup	1997
Decommissioned SVE in Area 2, abandoned selected ground water monitoring wells, changed ground water pumping schedule	1998
Completed first Five-Year Review	1998
Turned over TIW well to land owner, investigated additional areas where plume could migrate, identified additional domestic water supply wells where plume migrated, see attached semiannual reports for more details	1999
HRC® study approved and conducted on plant site near treatment lagoon	2001
Extraction system hit by ice storm. Lindsay requested that EPA and NDEQ consider using water for crop irrigation, approval given	2002
Initiated second Five-Year Review process	2003
Conducted Five-Year Review inspection. Held public availability session, sampled three domestic water supplies. Provided results to owners.	2003
Quarterly ground water sampling. Samples collected during February, May, August and November each year. Fifty seven quarters of data collected through February 2003	2003
Subsurface Investigation and Ground Water Monitoring Report Prepared	2003
EPA Certification of Completion of the Remedy at time goals achieved	Not yet certified

III. BACKGROUND

Physical Characteristics

Lindsay Manufacturing Company operates a manufacturing facility on 42 acres and manufactures galvanized irrigation systems. Lindsay is located in the Village of Lindsay, Nebraska, in Platte County. The Village of Lindsay lies on the east boundary of the Nebraska sandhills and the local region is characterized by rolling and dissected loess plains. The site is surrounded on the north and east by farmland and on the south and west by the Village of Lindsay. Wastes from the galvanizing process were discharged into an unlined earthen lagoon for 10 years between 1972 and 1982. The site is surrounded by farmland with approximately 3,000 residents living within a 3-mile radius of the site, including the Village of Lindsay, Nebraska. Prior to the remedial actions, contaminants of concern at the site included: zinc, iron, cadmium, sulfate, chromium,

lead and volatile organic compounds (VOCs), including dichloroethylene, dichloroethane, tetrachloroethylene and trichloroethane. People could have been exposed to contaminants by drinking water from contaminated domestic wells, by direct contact with contaminated water, by inhaling contaminants released during water use or by eating food in which contaminants have bioaccumulated.

Land and Resource Use

The site is bounded on the north by farmland, on the east by Lindsay town limits and farmland, on the south by state highway 91 and a residential area of Lindsay, and on the west by a tributary to Shell Creek, its greenbelt and a residential area of Lindsay. In 1980 the total population of Lindsay, Nebraska was 383 people. Three schools serve the Lindsay area. Land use within the city limits is primarily residential with the exception of the Lindsay Manufacturing site and a community business and general commerce area located southwest of the site. A public recreational and utility area is located approximately 0.2 miles southwest of the site. The utility area consists of the town public sewage treatment plant and ponds. Use of the area located within a two-mile radius of the Lindsay town limits is primarily agricultural with an average of three farmsteads per square mile. Depth to ground water ranges from approximately 25 feet at OIW to approximately 55 feet at MW93-3A. Table 1 of the January 30, 2003 report shows all the measured depths from April 1997 to November 2002.

The site is in the upland drainage area of Shell Creek. The western boundary of the site is a tributary draining to Shell Creek (Dry Creek) which has received nearly continuous discharge from the interim ground water remediation operation. The treated waters are monitored by the facility's National Pollution Discharge Elimination System (NPDES) permit. Ground water flow in the vicinity of Lindsay, Nebraska is generally to the south. The aquifer thickness ranges from 35 to 50 feet. The average ground water flow velocity is about three feet per day. Ground water flow direction at the site is complex because of the influence of several high capacity wells.

History of Contamination

The site was originally a gasoline station until the late 1950's. In 1958, Paul Zimmer began manufacturing irrigation systems. In 1961, the plant was constructed and in 1965, Lindsay Manufacturing began. Disposal of materials from plant operations historically included discharge of spent acid from the galvanizing building. From the early 1970s to 1982, a spent acid stream was piped to an earthen disposal pit located north of the company's galvanizing building. In 1982 Lindsay replaced the pit with a new wastewater treatment facility designed to neutralize the spent acid. During the installation of the wastewater treatment facility, four wells and a deep test hole was drilled and sampled in January 1983. The samples revealed the ground water had abnormal acidity and temperatures. Lindsay reported these findings to NDEQ and began an investigation of the soils and ground water.

Initial Response

In 1984 Lindsay began operating a ground water extraction and treatment system, whereby the ground water is treated by neutralizing and removing contaminants (Original Interceptor Well - OIW). A second extraction well (Add-On Interceptor Well - AOIW) was installed in 1989, to control off-site migration of contaminants and increase the radius of influence. Lindsay began a study of the nature and extent of contamination remaining at the site and completed its study in 1990.

The site was proposed to the NPL on October 15, 1984, and became final on October 4, 1989. In response to a release or a substantial threat of a release of hazardous substance(s) at or from the site, Lindsay initiated an RI/FS on January 5, 1988. The RI report was completed on June 20, 1990, and an FS Report was completed on August 27, 1990. On July 10, 1990, the Proposed Plan identifying the preferred remedy was presented to the public for their review and comment, along with the final RI and draft FS reports.

Basis for Taking Action: Contaminants

Hazardous substances that have been released at the site include sulfate, zinc, iron, cadmium, chromium, lead and volatile organics from former process waste. Off-site ground water contains heavy metals including cadmium, zinc, and VOCs including 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene, tetrachloroethylene, 1,1,1-trichloroethane and trichloroethylene. These VOCs have been identified in the perched sand channel in the northern half of the site, in clay soils in the area around the northern quarter of the main plant, and between the main plant and the southern end of the galvanizing building. People could be exposed to contaminants by drinking water from contaminated domestic wells, by direct contact with contaminated water, by inhaling contaminants released during water use, or by eating food in which contaminants have bioaccumulated.

IV. REMEDIAL ACTIONS

Remedy Selection

The EPA selected a remedy that included a pilot study to evaluate the feasibility of vacuum extraction of on-site soils, installation of such a system if it is deemed practical, enhancement and utilization of the existing ground water extraction and treatment systems, installation of additional ground water monitoring wells, installation of an additional extraction well, and continued monitoring of the ground water collection/treatment system during cleanup activities.

The ROD for the Lindsay Manufacturing Superfund site was signed on September 28, 1990. The Remedial Action Objectives (RAOs) were developed as a result of data collected during the

remedial investigation to aid in the development and screening of remedial alternatives to be considered for the ROD. The RAOs for the site were to:

1. Prevent current or future exposure to the contaminated ground water;

2. Determine the practicability of reducing contaminant migration from the soil into the ground water;

3. Implement soil vapor extraction, if practicable; and

4. Restore the ground water aquifer to MCL quality.

The major components of the remedy selected in the ROD include:

1. A pilot study to evaluate the practicability of vacuum extraction of organic compounds from contaminated soil.

2. If determined to be practicable by EPA and/or NDEQ, design and implementation of full scale soil vapor extraction system based on pilot study data.

3. Enhancement of the existing ground water extraction and treatment system by either increasing the volume of on-site pumping from the existing extraction wells or by the installation of an additional interceptor (extraction) well.

4. Utilization of the existing ground water monitoring wells near irrigation well #54278 to further delineate the ground water contaminant plume.

5. The monitoring of the ground water collection/treatment system and the ground water contaminant plume during ground water remediation activities.

6. If appropriate to protect human health, EPA and NDEQ will evaluate options, as part of implementation of the ROD, to ensure that drinking water wells are not installed in areas of the contaminant plume on-and off-site.

Remedy Implementation

In a Consent Decree (CD) signed with EPA on April 9, 1992, the responsible parties agreed to perform the remedial design/remedial action (RD/RA) and pay past costs for cleaning up the site. The RD was conducted in conformance with the ROD. The RD was approved by EPA in 1992. In early 1993, a third extraction well became operational to assist in pumping and treating the ground water. The SVE pilot study was concluded in 1993. Design of the full-scale SVE system was completed in mid-1994; construction began shortly thereafter and the SVE system became

operational in early 1995. In 1996, EPA evaluated the SVE system and determined site specific remediation goals had been attained and verified. Once verified, the SVE system equipment was decommissioned and the site restored. The EPA also evaluated the use of irrigation as a means for disposal of the removed ground water. The Nebraska Department of Health performed a risk assessment and the results of this assessment determined that no unacceptable risks were associated with using irrigation as a disposal option. The EPA modified the ground water pumping and is allowing the pumped water to be beneficially reused for irrigation. This reduced the operating costs by approximately $100,000 annually. The EPA completed the First Five-Year review of the site activities in 1998, which served to document the modifications to the extraction and treatment system and also determined that the remedy remained protective of human health and the environment.

Lindsay Manufacturing and EPA have sampled downgradient domestic water wells since 1990. The wells that have been sampled are shown in Attachment 2, the Site Plan. Until 1998 only irrigation well #54278 and the Beller stock and domestic wells contained the contamination plume. In 1998, the Priester domestic well showed the presence of tetrachloroethene above the MCL. The other domestic wells remain free of contamination.

In May 1998 Lindsay proposed conducting a 3-month treatability study utilizing MW89-12 as the extraction well. Lindsay determined that water could be extracted from this well at a rate of 60 gallons per minute. The extracted ground water would be piped into the settling pond for air stripping through a modified irrigation system. As the residual contamination is in the top of the aquifer, pumping only the upper zone would be more efficient pumping the entire aquifer. In October 1998, the EPA notified Lindsay Manufacturing that EPA and NDEQ supported the modification to use MW89-12 as the extraction well, provided all remediation wells (OIW, AOIW, and TIW) remain in place until remediation goals are attained. In addition, the EPA and NDEQ support the use of the low level contaminated ground water as irrigation water during the summer months. In the fall of 1998, MW89-12 removed 6.2 million gallons of contaminated ground water from the aquifer. In March 1999, OIW well removed 30.5 million gallons of water from the aquifer. In the next six months, MW89-12 removed 12.8 million gallons of contaminated ground water. In August 1999, several nearby domestic residents' water supplies were tested to determine if they contained contamination from the Lindsay site. No new domestic supplies were found to contain contamination from Lindsay above the MCLs.

In November 2000, the EPA held discussions with Lindsay for them to explain the levels of contamination present in selected monitoring wells. Monitoring well MW89-14 is located in the "sandy channel" area of Lindsay and the water in this well is from infiltration. MW89-15 is a deeper well and is screened in the upper portion of the sand and gravel aquifer. Water levels in the sand and gravel aquifer fluctuate each summer based on seasonal irrigation demand. As the water levels drop, ground water in the perched sand channel and in the silty clays between the sand channel and the aquifer drain, in part, to the aquifer. The silty clays between the sand channel and the aquifer contain chlorinated solvent residuum that continues to release to the

release to the aquifer. In 2000, drought conditions resulted in wider seasonal fluctuations in water levels in the aquifer. Monitoring well MW89-12 is in an area with mixed permeability. The upper portion has very low permeability. The lower portion of the screened interval is in the upper portion of the ground water, therefore the levels of the VOCs removed from the pumping of this well reflect the contamination as it drains into the aquifer. See Attachment 3, the January 30, 2003, letter report to EPA, for further details. Remediation efforts are focused on the capture of the VOCs present to protect the aquifer and to enhance the degradation of the contamination present. In 2000, approximately 23,000,000 gallons of contaminated ground water were removed from monitoring well MW89-12. Irrigation wells removed contaminated ground water, but the amount used for irrigation was not recorded. In 2001, approximately 19,000,000 gallons of contaminated ground water were removed from monitoring well MW89-12. Irrigation wells were used to remove the contamination migrating from the plant site.

In 2001, Lindsay proposed to do additional work using an innovative technology, hydrogen release compound or HRC®, to address the residual aquifer contamination. The HRC® was injected into the aquifer at 22 locations. One hundred and fifty pounds of HRC® was injected at each location. This work was completed in September 2001. Quarterly ground water monitoring was modified to include the inorganic parameters used to assess the effectiveness of the HRC®. The ground water monitoring program was modified to test for the inorganic parameters (dissolved oxygen, oxygen release potential, sulfate, sulfide, dissolved iron, total iron) at monitoring wells close to the injection locations. As of February 2003, the field parameters monitored have not clearly indicated a change in the subsurface chemistry. This could be due to the soils at the site or the drought conditions which would have accelerated the movement of the HRC® from the treatment zones into the aerobic aquifer. The EPA will continue to work closely with Lindsay to determine if there are ways to address this residual contamination present and to prevent the migration of the source beyond its current location.

The ground water analytical results from the 38th to the 57th quarter are presented in Attachment 5 of this document. The analytical results indicate that, for the most part, the ground water plume is contained in isolated areas between ground water monitoring well MW89-14 in the perched sand channel, to monitoring well MW89-12, the top of the aquifer, to the area located near MW-92-3, to the Priester's domestic well. The EPA is concerned that, unless further investigation and response action is undertaken, this plume may continue to expand.

System Operation, Operation and Maintenance

Lindsay Manufacturing is conducting ground water monitoring and maintenance activities pursuant to the Operation and Maintenance Plan (OMP) that was approved by EPA in the 1992 CD. The primary activities associated with the OMP include:

1. Inspect the condition of the monitoring well network, the extraction system and the irrigation system used for disposal of the extracted water.

2. Conduct quarterly ground water monitoring until the MCLs are reached; and

3. Prepare reports of the ground water monitoring information and send to EPA on a biannual basis.

O&M costs include sampling and monitoring efforts, monitoring well maintenance, and writing reports. Operation costs for the past five years are as follows in Table 2:

Table 2 - Operating Costs

Year	Costs
1998	$112,207
1999	$138,913
2000	$128,813
2001	$ 99,035
2002	$181,145
2003	$ 75,742, January through April

The 2002 costs were elevated due to the billing for the HRC® work in 2002 and the increased monitoring for the domestic supplies and the increased monitoring of the HRC® work efforts. The domestic water issues resulted in additional consulting charges, engineering time and laboratory costs not experienced in prior years.

V. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

Ground water extraction and treatment by use of irrigation systems continued during the past five years. Approximately 1226 pounds of VOCs were removed in approximately 74 million gallons of water. Ground water monitoring continued for selected existing monitoring locations. Monitoring of the quality of the drinking water at the Priester's and Beller's continue on a frequent basis. Bottled drinking water is currently being supplied to the Beller residence. The Priester household has a whole house treatment system which has experienced some problems in the past. The existing household systems have shown breakthrough of the contaminants. Lindsay Manufacturing has designed a new total house treatment system for installation at each location. Other domestic supplies in the area have been tested and were free of contamination from the Lindsay Manufacturing site. Efforts will continue to include identification of any additional domestic supply wells which could be impacted by this plume, as well as additional efforts to address the plume prior to further migration. Table 3 contains the ground water

range of the contaminant and the time the maximum was experienced, as well as the range of contaminants during the last four sampling events.

VI. FIVE-YEAR REVIEW PROCESS

Administrative Components

Members of the responsible parties and the state of Nebraska were notified of the initiation of the Five-Year Review. The Lindsay Manufacturing Five-Year Review team was led by Diane Easley, (Remedial Project Manager - RPM) for the site, and included Kirk Morrow, NDEQ. The review was conducted between January 7, 2003, and May 20, 2003. It included community involvement during the public availability session held on February 12, 2003, document review, data review, site inspection, local interviews, and report development and review.

Community Involvement

Activities to involve the community in the Five-Year Review were initiated in February 2003 by the RPM and the Community Involvement Coordinator for the site. A notice was published in the Columbus Telegram on February 9, 2003, and a fact sheet was sent to the Lindsay parties on the EPA mailing list explaining the initiation of the Five-Year Review. The notice and fact sheet invited the public to submit any comments to EPA. A public availability session was held at the community center on February 12, 2003. Approximately 20 citizens were in attendance. Several comments concerning the ongoing work efforts and the impacts to the community and the ground water were received and discussed.

Soon after approval of this report, a notice will be placed in the same local newspaper announcing that the Five-Year Review is complete, and that the results of the review and the report are available to the public at the Columbus Public Library and the EPA Region 7 Record Center.

Document Review

This Five-Year Review included a review of relevant documents including O&M records and monitoring data.

Data Review

Ground water monitoring was first conducted at the site in 1982 with the installation of the OIW. The most recent ground water monitoring effort was conducted in May 2003. Quarterly sampling events are conducted in February, May, August, and November. Reports of the information collected at the site are presented to EPA on a semi-annual basis. The most recent report was received by EPA on April 14, 2003. Ongoing discussions are being held with the two

parties with domestic wells affected by the Lindsay plume. Lindsay is currently supplying bottled drinking water to the Bellers and a whole house treatment system to the Priesters, which delivers water free of contamination.

The quarterly sampling conducted in February 2003 was the 57th quarterly sampling event. Summary sheets showing the contamination present at each monitoring location are presented in Attachment 5. Figure 2 shows the location of the wells and the area affected by the Lindsay plume. Domestic party wells were sampled and are shown on Figure 3. Other than the Beller's and the Priester's, all wells were found to be free of the contamination migrating from the plant site.

Tables for each well are presented in Attachment 5.

Table 3-Ground Water Monitoring 1998-2003
Concentration Range of Three Contaminants of Concern
In micrograms per liter (ug/l)
Date (month and year) of Maximum Occurrence Shown

Sampling Location	1-1-DCE, (MCL 7)	111-TCA, (MCL 200)	PCE, (MCL 5)	Screen Location
MW87-3 aquifer	5U[1]-27, max 2-03	5U-40, max 5-01	5U-8, max 2-03	135' deep, 46' well screen
range last 4	12J-27	5U-29	5U-8	
MW89-15 up aquifer	6-280, max 8-01	25-520, max 8-00	15-170J, max 8-02	63' deep, 10' well screen
range last 4	46-130	51-290J	38-170J	
MW89-14 sand chan.	5U-49, max. 2-98	5U-94, max 2-98	5-43, max 2-98	44' deep, 10' screen
range last 4	5U-12J	5U-19J	6-11	

[1] A U-code indicates the limit of reportable detection limits. A J-code indicates that the compound was present and an "estimated" value is reported. The J-code is usually applied when the sample was analyzed after the holding time limit was exceeded.

MW89-12[2] up aquifer	11-310, max 2-98	9-450, max 2-98	32-1700, max 2-98	72' deep, 10' well screen
range last 4	19J-78J	11J-110	28J-400,	
OIW	5U-120J, max 8-02	5U-290J, max 8-02	5U-110J, max 8-02	40' screened interval, 95' deep
range last 4	13-120J	7-290J	16-110J	
AOIW	5U	5U-6	5U	130' deep, 30' screened interval
range last 4	5U	5U-6	5U	
MW92-3A up aquifer	5U-67, max 5-02	14-130, max 5-00	6-56, max 5-02	88.5' deep. 10' well screen
range last 4	5-67	63-89	23-56	
MW92-3B low aquifer	5U-59, max 2-98	5-210, max 2-98	5U-98, max 2-98	125' deep. 10' well screen
range last 4	5U	5-12J	5U-6	
Priesters	1U-80, max 5-02	1U-170, max 5-00	1U-69, max 5-00	domestic supply
range last 4	24-30J	47-54J	24-30J	

Ground water elevations fluctuate during the year. The contamination is present in the sand channel and during the irrigation season, the contaminants are drawn from the sand channel into the upper aquifer. VOCs generally peak during the August sampling period. Monitoring well MW89-15 is located nearest to the residuum and serves as an indicator of the amount of VOCs transferred to the aquifer. MW89-12 serves as an extraction well and the levels of VOCs present in this well indicate the amount of contamination present in the upper aquifer. From 1995 to

[2] Note: MW89-12 currently serves as an extraction well. From May 1998 to February 2003 the total pounds of volatiles extracted by pumping this well was 225.5 pounds in 74.3 million gallons of water. During 2002 MW89-12 was damaged by a winter storm. After repairs were made, Lindsay requested that EPA and NDEQ consider drop irrigation as a reuse option. The request was granted and the extracted ground water was used on crops.

2002 the levels of total VOCs have fluctuated from a low of less than 120 ug/l in 1996 to a high of greater than 1000 ug/l in 2001. Previous elevated levels of VOCs were in the 1997-1998 time period where the total VOCs were in the 2000-3000 ug/l range. MW89-14 contains levels of contaminants that are approaching the MCLs. The extraction well OIW had levels nearing the MCLs in 1999, but those levels rebounded and were elevated in August 2002. This could be in response to the drought conditions that the Lindsay area experienced. Monitoring well MW87-3 and AOIW show levels of VOCs near the MCLs for the past several years. Monitoring wells MW92-3A and MW92-3B show the contamination in the shallow and deep portion of the aquifer. MW92-3A is currently showing elevated levels of the contamination, while MW92-3B is declining.

There are three primary wells on the Beller's property. They include the Beller irrigation well, the Beller stock well and the Beller domestic well. Sampling of these wells have been somewhat intermittent during the past five years. The Beller irrigation well (#54278) was part of the remediation system until 1998 when the levels of contaminants achieved clean up levels. Monitoring continued quarterly until August 1999 after eight quarters of data indicated that the well was no longer impacted by contamination. The Beller stock well was sampled four times during the past five years. The levels of contaminants in this well have increased considerably and this well will be monitored annually in August along with the irrigation well. The Beller domestic supply well had been sampled on a quarterly basis until November 1999, and was not sampled again until September 2002. The levels of contaminant have increased in this well and PCE was present in the Beller's domestic supply well above the MCL.

The Priester's domestic supply well exhibited high levels of contamination in May 2000 and May 2002. Lindsay continues to monitor this supply well frequently. Priester's stock well was sampled and was found to contain carbon tetrachloride. The Priester's stock well is located near some grain storage bins. Carbon tetrachloride has been used in the past for grain fumigation. Carbon tetrachloride has not been present in the ground water from the Lindsay Manufacturing site and therefore is not considered to be associated with the Lindsay Manufacturing Superfund site.

The Lindsay area experienced drought conditions in the summer of 2002. The ground water elevations reflected these conditions. The levels of total VOCs in MW-89-12 ranged from a low in May 2002 of 60 ug/l to a high of 504 ug/l in November. In February 2003 the levels of total volatiles remained high and were 529 ug/l.

Site Inspection

An inspection was conducted at the site on February 12, 2003, by the state and EPA. The purpose of the inspection was to assess the protectiveness of the remedy, the location of any nearby residents, the location of the extraction well and the location of the ground water

monitoring wells. This site includes the Lindsay manufacturing facility where site access is restricted. There are no institutional controls on the plant site property.

Examination of the site revealed the following: No major operation and maintenance problems were identified at the plant site. The plant site is a manufacturing facility with limited access to the general public. The location of the extraction well (MW89-12) was identified. The discharge pipe from the extraction well to the irrigation system was broken. This pipe was fixed and a digital picture showing the system operating was sent to EPA on May 15, 2003 and shown in Figure 5. All monitoring wells were located and were found to be in good condition. All known domestic supply wells downgradient of the site in the pathway of the plume were identified. Ground water information is being presented to EPA and NDEQ on a bi-annual basis, so no documents were reviewed by EPA or NDEQ during the site inspection. The EPA and NDEQ met with the current residents impacted by Lindsay (Priesters and Bellers) to discuss the situation and the work which Lindsay is required to perform under the Consent Decree. Both EPA and NDEQ encouraged the parties to complete the discussions with Lindsay for the installation of the whole house treatment systems. Lindsay is testing domestic supplies, stock wells and irrigation wells, and providing each party with the analytical results of all testing performed on their wells (domestic, stock or irrigation). It was noted that the Priester's stock well was contaminated with carbon tetrachloride, a contaminant not previously identified in the Lindsay plume. The EPA believes that the carbon tetrachloride is from grain fumigation. No other VOCs were present in the Priester's stock well above reporting limits.

Interviews

The EPA and NDEQ participated in interviews with representatives of the village of Lindsay during the public availability session. The community expressed concern that Lindsay was not doing everything possible to protect the residents of Lindsay which were on domestic supply wells. The EPA and NDEQ discussed the efforts which Lindsay had undertaken to be protective of health and the environment, and the further actions that Lindsay was anticipating to conduct to protect those parties affected. There was concern expressed by some in attendance that the analytical results that Lindsay produced may not be reflective of the contamination present in other domestic supply wells. The EPA agreed to test any domestic wells downgradient (south) of the facility, in the area to which the plume could potentially migrate. The EPA tested three domestic water supply wells and all were found to be free of the contamination. Figure 2 shows the location of the known domestic supply wells downgradient of the manufacturing facility.

VII. TECHNICAL ASSESSMENT

Question A: Is the remedy functioning as intended by the decision documents?

The review of documents, Applicable or Relevant and Appropriate Requirements (ARARs), risk assumptions, and the results of the site inspection indicates that the remedy is functioning as

intended by the ROD. This is the second Five-Year Review. Information from the first Five-Year Review presented evidence that the soils were remediated by SVE, but the ground water remained contaminated. Lindsay Manufacturing petitioned the NDEQ to modify the on-site remediation goals for three secondary contaminants. The NDEQ, with EPA's concurrence, modified the on-site goals for sulfate, iron and pH on the manufacturing plant site. These modified goals were: elevating the sulfate level for on-site ground water to 500 mg/l, iron to 10 mg/l and pH to >5. Off plant property goals remain unchanged at the secondary standards for drinking water. There is concern that the plume has continued to migrate off plant property, beyond the capture zone of the irrigation wells and will continue to migrate beyond its current location.

Lindsay has collected ground water samples from domestic, stock and irrigation wells located downgradient of the known extent of the current plume. Lindsay is preparing to perform additional work to identify the location of the plume and determine if there are other work efforts which can be performed to prevent exposure to the plume and to halt further migration. Quarterly monitoring of existing monitoring wells and domestic supply wells will continue until remediation goals are attained. Lindsay is also installing whole house treatment systems at the Beller's and Priester's. As far as the operation of the extraction system, there were no opportunities for system optimization observed during this review. The existing monitoring well network provides sufficient data to evaluate the effectiveness of the remedy on plant property. At least one additional monitoring well downgradient of the Priester's will be installed and screened in appropriate zones to determine the extent of the ground water plume. Additional investigative work efforts to determine the extent of the ground water plume using direct push technologies and a mobile laboratory may be needed to characterize the vertical and horizontal extent of the plume in the southern regions of the site. This information would enable EPA and NDEQ to ensure ground water contaminant levels remain protective of human health and the environment. Except for the Bellers and Priesters domestic supplies, ground water monitoring results from domestic supplies downgradient of Lindsay, as shown in Figure 3, do not exhibit the contamination from Lindsay

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy selection still valid?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

1. Changes in Standards and To Be Considereds

The remedial construction work at the site has been completed, and all ARARs cited in the ROD remain as goals for the off-site plume. For the plant site plume, the three secondary goals have been modified.

2. Changes in Exposure Pathways, Toxicity, and other Contaminant Characteristics

The exposure assumptions used to develop the Human Health Risk Assessment included both current exposures and potential future exposures. There have been changes in the toxicity factors for the contaminants of concern that were used in the baseline risk assessment. These were minor changes and, if used in the risk assessment today, would result in a higher performance goal than the goal presented in the ROD. The ROD assumptions are considered to be conservative and reasonable in evaluating risk and developing risk-based cleanup levels. No change to these assumptions, or the cleanup levels developed from them, is warranted. There has been no change to the standardized risk assessment methodology that could affect the protectiveness of the remedy. The identification of carbon tetrachloride in the Priester's stock well is a new development. The levels were just above the MCL of 5 ug/l. This well is being used exclusively for livestock and is not used as a domestic supply. The carbon tetrachloride is not a contaminant from the Lindsay plant site and EPA believes that it is from being used in grain storage.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Yes. The ground water monitoring information indicates that the ground water plume has continued to migrate beyond the plant property. Additional work efforts will be undertaken to ensure that no one is using the contaminated water for domestic supply. Additional work efforts will also be undertaken to determine if there are locations where treatment wells can be installed to capture the plume and to halt further spread. Lindsay has monitored the domestic supply wells downgradient of the plume. To date, only two domestic supply wells have been impacted. Additional work will be undertaken to address the migration of the plume. Additional work will also include installing one or more monitoring wells downgradient to the Priesters to determine the extent of the plume. This work would include site investigative work or installation of additional irrigation wells to reduce the contamination in the ground water.

Technical Assessment Summary

According to the data reviewed, the site inspection, and the interviews, the remedy is functioning as intended by the ROD. There have been no changes in the physical conditions at the site that would affect the protectiveness of the remedy. The ARARs cited in the ROD are still valid. The cleanup goals have not been met. There have been minor changes in the toxicity factors for the contaminants of concern that were used in the baseline risk assessment, and there have been no changes to the standardized risk assessment methodology that could affect the protectiveness of the remedy. There is no other information that calls into question the protectiveness of the remedy.

VIII. ISSUES

Table 4 - Issues

Issue	Currently Affects Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
Evidence that the plume may be continuing to migrate	N	Y
Evidence the plume has impacted domestic supplies	Y	Y
Evidence that additional extraction efforts are needed to control the spread of the plume	N	Y

IX. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Table 5 - Recommendations and Follow-Up Actions

Issue	Recommendation / Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Y/N)	
					Current	Future
pipe from MW89-12 to irrigation well broke	Fix pipe and connect to irrigation pivot.	Lindsay	State/EPA	Complete 5/12/03	Y	Y
New irrigation pivot installed	Installed new center pivot system north of plant site	Lindsay	State/EPA	Complete 5/15/03	Y	Y

Issue	Recommendation / Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Y/N)	
					Current	Future
Verify if any other domestic supplies affected	Lindsay will verify all domestic supplies downgradient beyond Priester's	Lindsay	State/EPA	9/30/03	Unlikely	Y
Monitor water quality in other wells	Lindsay will add irrigation wells and Beller's stock well to the August sampling event on annual basis	Lindsay	State/EPA	8/15/03	N	Y
Domestic supply wells	Install effective treatment systems to ensure delivery of contamination free water	Lindsay	State/EPA	11/30/03	Y	Y
Extent of Plume	Install monitoring well(s) south and east of Priester's domestic supply well	Lindsay	State/EPA	12/31/03	Unlikely	Y
Add one or more pumping well	Install an extraction well located between MW-92-3 and Priester's domestic well	Lindsay	State/EPA	12/31/03	N	Y

X. PROTECTIVENESS STATEMENT

The remedy at the site is currently protective of human health and the environment. There are no known nearby residents currently being exposed to the Lindsay contamination. Lindsay is conducting quarterly ground water monitoring of all domestic supply wells identified in the

pathway or potential pathway and, for those found to be contaminated, are providing treated water or whole house treatment systems. Additional irrigation wells may be installed to halt the migration of the contaminant plume.. Additional monitoring wells are needed to define the extent of the downgradient region of the ground water plume. All other threats have been addressed by prior efforts.

Long-term protectiveness of the RA will be verified by continued inspections, maintenance, and sampling of the ground water at the site as specified in the operation and maintenance plan. Current data indicate no exposure to ground water contaminants in the wells in the surrounding area other than the Beller's and Priester's supply wells. These two domestic wells are currently being treated to remove the contamination. Current monitoring indicates that the remedy is functioning as intended.

XI. NEXT REVIEW

The next Five-Year Review for the Lindsay Manufacturing Superfund Site is required five years from the date this review is signed. The EPA and NDEQ may consider conducting another review of the effectiveness of the systems at Lindsay earlier, if conditions change or otherwise warrant such evaluation.

ATTACHMENTS

ATTACHMENT 1

Site Location Map

ATTACHMENT 2

Site Plan Showing Monitoring Well Locations and other Figures

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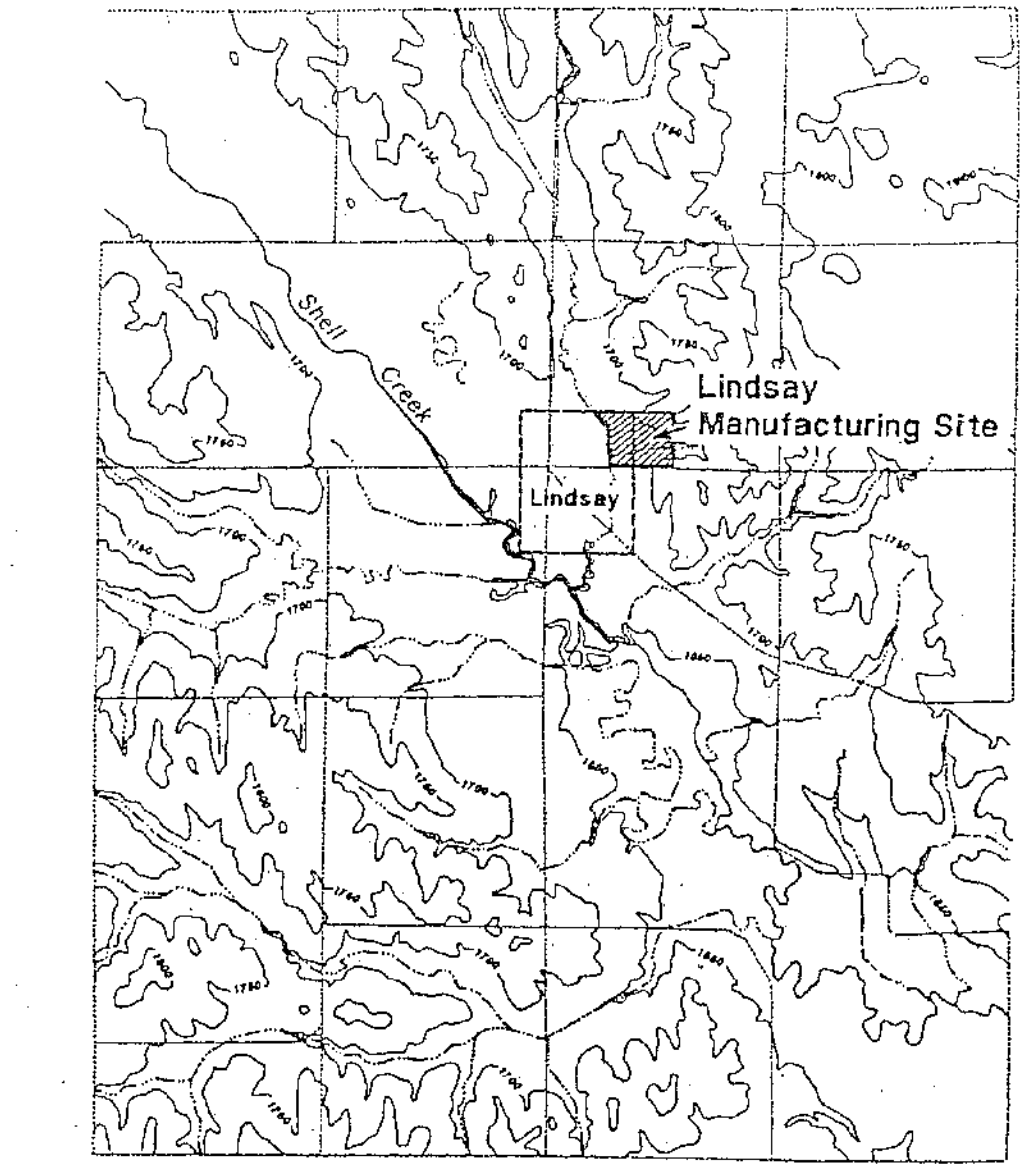


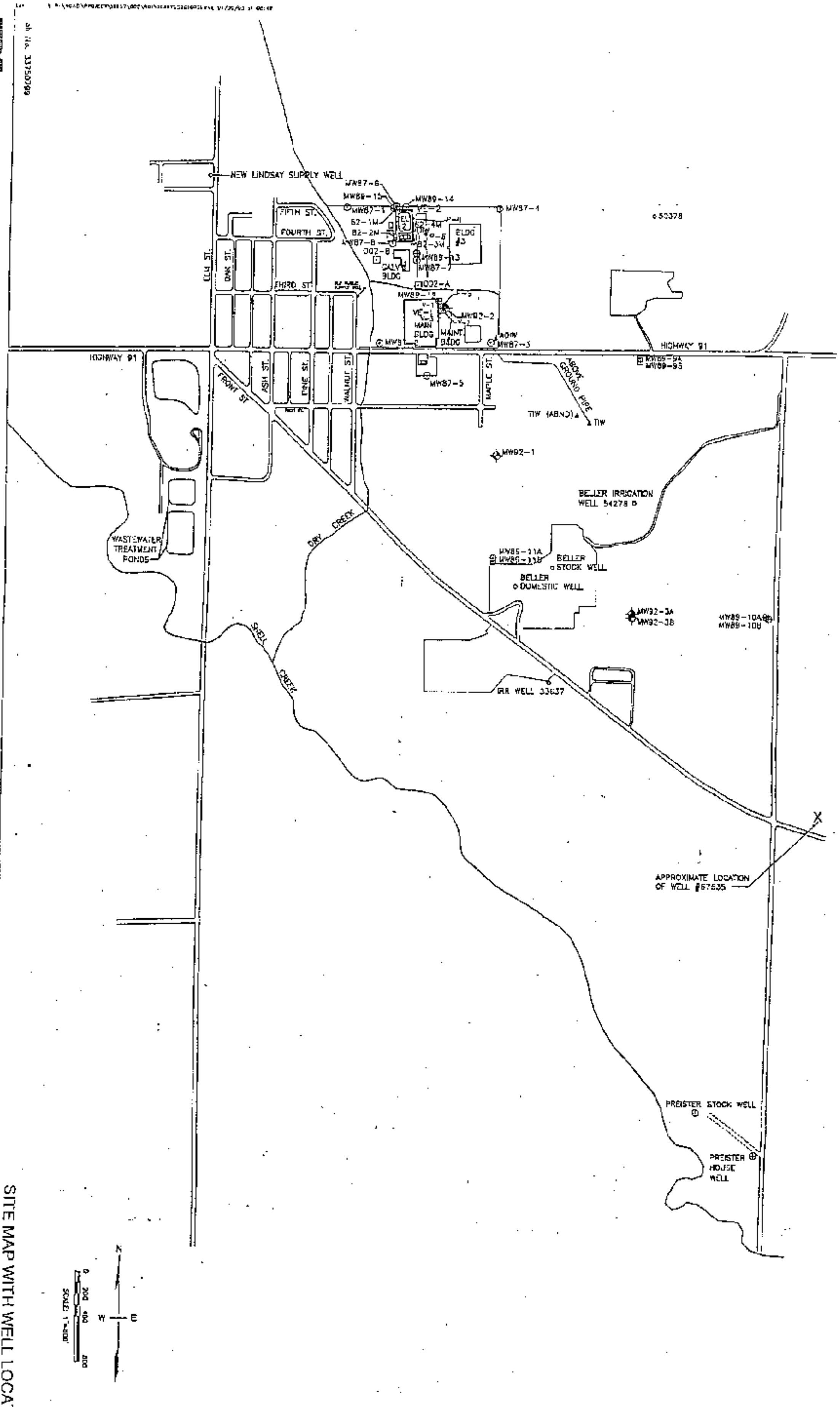
Job No. 16657-002-005

Reference: Lindsay Quadrangle, Nebraska,
7.5 Minute USGS Topographic Map, 1966.

Figure 1
~~Figure 1.2-1~~
Vicinity Map
Dames & Moore

ATTACHMENT 2

Site Plan Showing Monitoring Well Locations and other Figures

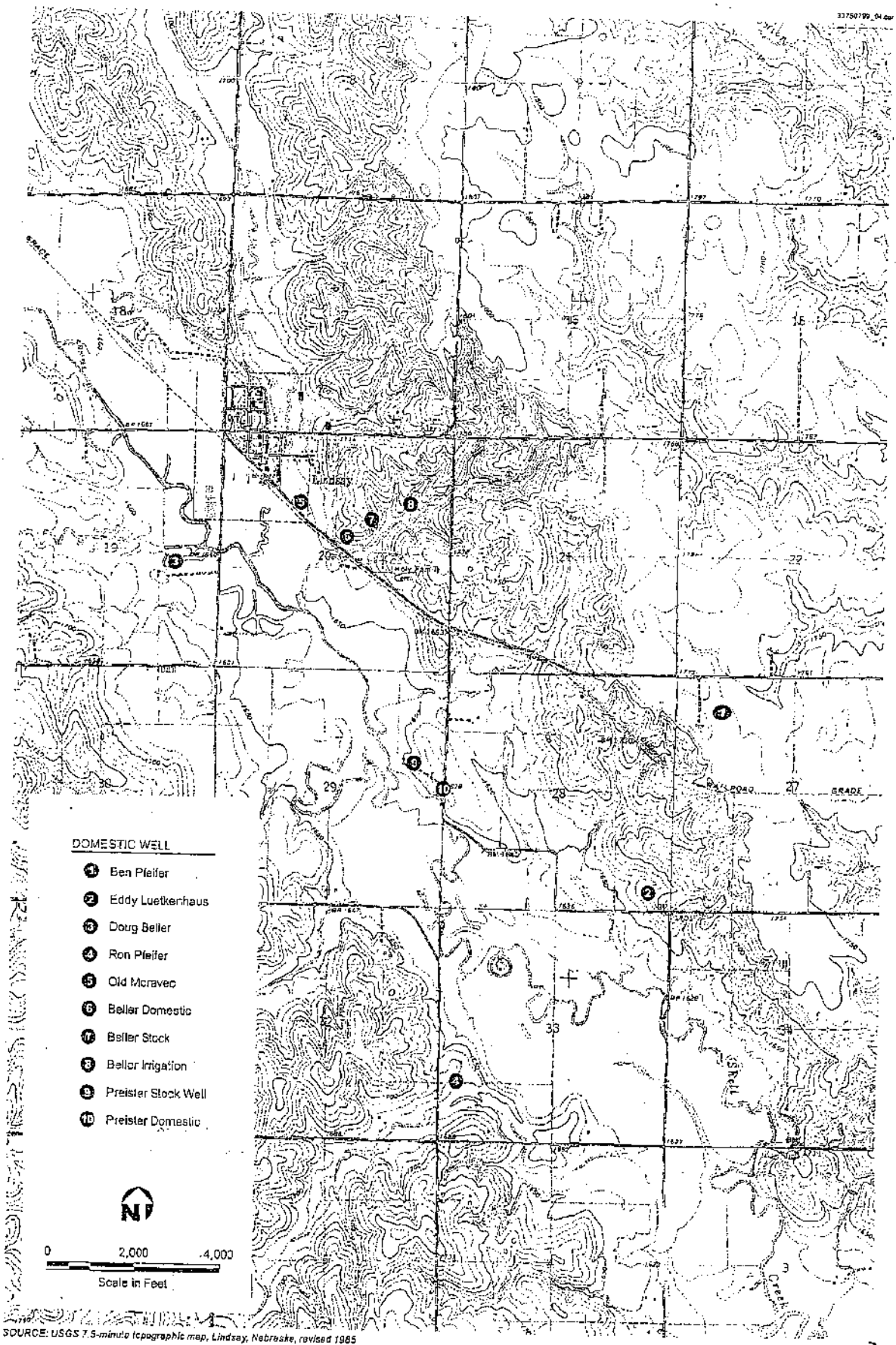


URS

Job No. 33750799

SITE MAP WITH WELL LOCAT

Lindsay Manu
Lindsay, N



SOURCE: USGS 7.5-minute topographic map, Lindsay, Nebraska, revised 1985

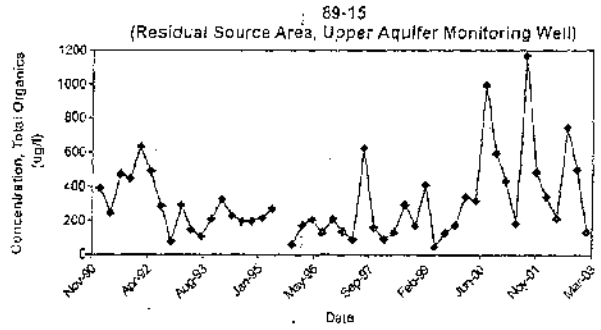
Job No. 33750799

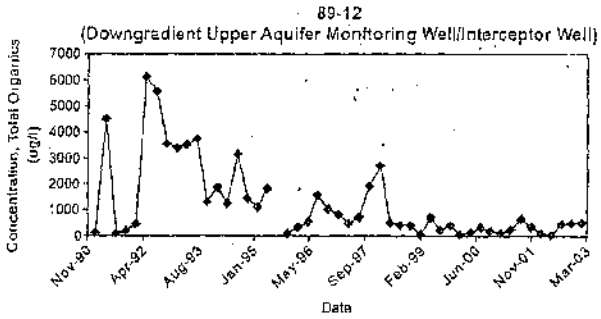
Figure 1

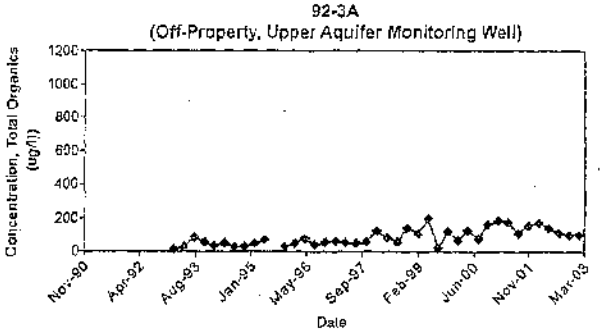
Approximate Locations of Domestic Wells
Sampled October 2002 to March 2003

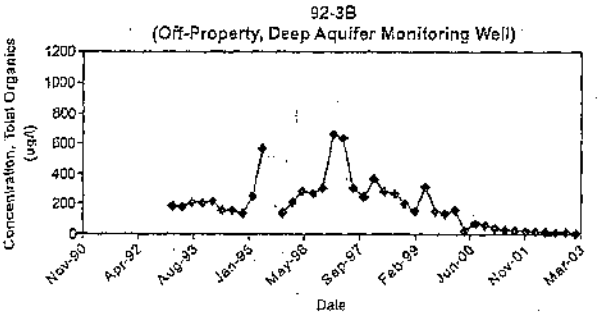
URS

Lindsay Manufacturing









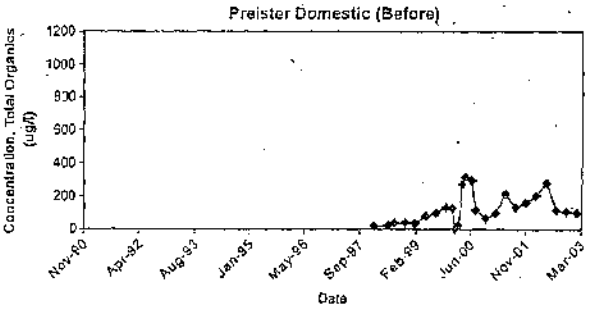
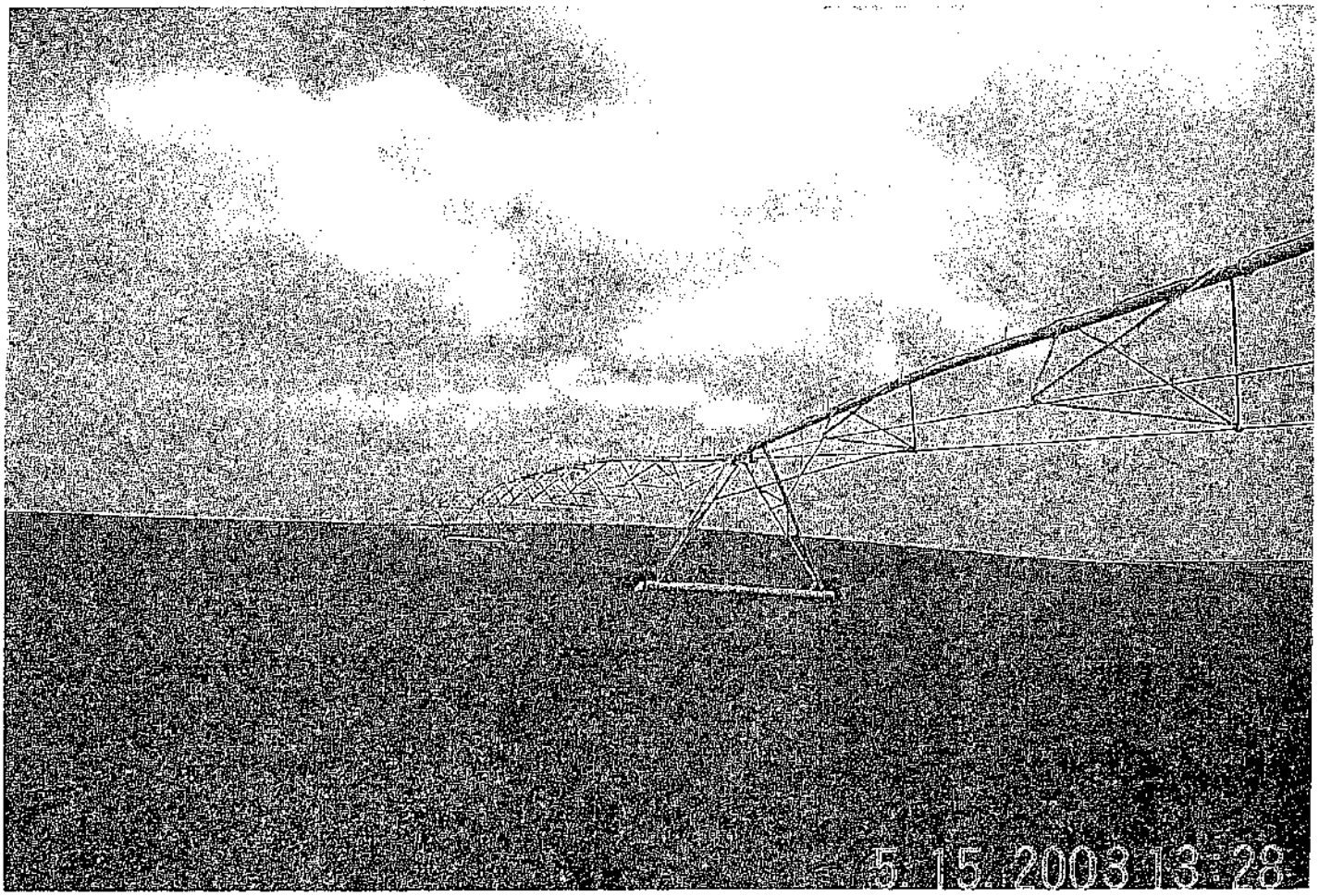


Figure 4

Concentration/Time Trends for Total Organics for Wells 89-15, 89-12, 92-3A, 92-3B, and Preister Domestic (Before)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ATTACHMENT 3

List of Documents Reviewed

Remedial Investigation for Lindsay, June 20, 1990

Risk Assessment by Nebraska Department of Health, 1989

Risk Assessment by Lindsay Manufacturing, 1990

Record of Decision, Lindsay Manufacturing Superfund Site, September 28, 1990

Consent Decree, United States v. Lindsay Manufacturing, April 1992

Final Remedial Action Work Plan for Ground Water, July 23, 1992, approved on August 18, 1992

Operation and Maintenance Plan for the Lindsay Manufacturing Site Ground Water Extraction and Treatment System, 1992

First Five-Year Report, July 1, 1998

Biannual Reports from Lindsay for years 1998, 1999, 2000, 2001, 2002 and 2003

Work Plan for Polishing Upper Aquifer Water, May 25, 2001

Letter report from URS dated January 30, 2003

Subsurface Investigation and Ground Water Quality at the Lindsay Manufacturing Facility, Lindsay, Nebraska dated May 1, 2003

ATTACHMENT 4

Applicable or Relevant and Appropriate Requirements (ARARs)

Medium/ Authority	ARAR	Status	Requirement Synopsis	Action to be taken to Attain ARAR
Safe Drinking Water Act (SDWA)	Federal - SDWA- Clean Water Act - 40 CFR 122-125 for point source direct discharge, NPDES effluent standards, discharge limits for metals and pH.	Relevant & Appropriate	CWA as guidelines from which states develop water quality standards. CERCLA §121(d)(2) requires compliance with such guidelines when they are relevant and appropriate. Federal MCLs are health-based criteria which have been developed for 95 carcinogenic compounds; these criteria consider exposure to chemicals from drinking water. Acute and chronic exposure levels are established.	The selected remedy has not yet attained MCLs at all locations within the monitoring well network.
Resource Conservation and Recovery Act (RCRA)	Federal 40 Code of Federal Regulations (CFR) Part 261and Nebraska Title 128,	Relevant, but no longer Appropriate	For sludge produced during the ground water treatment process, sludge produced is subject to RCRA requirements.	Sludge is no longer being produced, therefore, this regulation is no longer required.

Medium/ Authority	ARAR	Status	Requirement Synopsis	Action to be taken to Attain ARAR
Air/Clean Air Act & State Air Act	Nebraska Title 129	Relevant & Appropriate	These standards are emission level for volatiles at 2.5 tons/year emitted from the remediation system.	Emission levels from the ground water remediation system have been reduced to levels below the 2.5 tons per year. Extracted ground water is now used for irrigation.
Location Specific			Portion of site within 100-year floodplain, treatment facility outside floodplain	No location specific ARARs identified.

Attachment 5 - Monitoring Data and Site Reports

Volatiles: micrograms per liter (ug/l)
Well ID: Monitoring Well #87-3

Date	1,1-dichloroethene	1,1,1-trichloroethane	tetrachloroethene
11/94	NS		
2/95	230	570	780
5/95	NS		
8/95	130	300	690
11/95	NS		
2/96	180	270	470
5/96	NS		
8/96	88	170	98
11/96	NS		
2/97	9	22	32
5/97	NS		
8/97	180	270	780
11/97	NS		
2/98	9	16	25
5/98	7	9	9
8/98	5U	7	5J
11/98	7	12	6
2/99	12	18	5U
5/99	10	16	5U
8/99	7	18	5U
11/99	14	24	6
2/00	10	25	5U
5/00	10	27	5U
8/00	7	15	5U
11/00	15	29	5U

date	11-DCE	111-TCA	PCE
02/01	14	28	5U
05/01	17	40	5U
08/01	12	21	5U
11/01	19	30	5
02/02	22	30	6
05/02	14	22	5
08/02	12J	13J	5UJ
11/02	17	5U	8
02/03	27	29	8
05-03	23	24	11

Screened interval is 135' deep with a 46' well screened interval. This monitoring well should be reflective of the quality of the ground water in AOIW. This is considered to be an "aquifer" monitoring well. Lindsay well 87-3. September 17, 2001, work was initiated at the Lindsay site. This work included the injection of HRC, a patented substance which is a food grade poly-lactic acid. It's purpose is to induce a reducing environment in the aquifer which would cause the chlorinated volatiles to be reduced to substances which are then dissolved in the aerobic portion of the aquifer.

Monitoring Well # 89-12

Date	total VOCs	11-DCE	11-DCA	12-DCE	12-DCA	111TCA	TCE	PCE
MCLs, ug/l		7	no standard	170	5	200	5	5
11-97	1915	150	170	15	5U	260	20	1300
2-98	2696	310	180	27	5U	450	29	1700
5-98	513	79	24	5U	5U	130	5U	280
8-98	437	45	34	5U	5U	88	5U	270J
11-98	411	44	17	5U	5U	130	5U	220
2-99	71	15	5U	5U	5U	9	5U	47
5-99	708	63	15	5U	5U	270	5U	360
8-99	242	28	12	5U	5U	72	5U	130
11-99	416	40	16	5U	5U	110	5U	250
2-00	68	13	5U	5U	5U	20	5U	35
5-00	142	20	5	5U	5U	57	5U	60
8-00	341	35	28	5U	5U	48	5U	230
11-00	186	14	5U	5U	5U	42	5U	130
2-01	130	11	5U	5U	5U	31	88	130
5-01	251	33	12	5U	5U	66	5U	140
8-01	647	75	64	10	5U	120	8	370
11-01	379	54	29	6	5U	120	5U	170
2-02	117	24	5U	5U	5U	23	5U	70
5-02	60	18	5U	5U	5U	10	5U	32
8-02	468	78J	46J	5UJ	5UJ	84J	5UJ	260J
11-02	504	74	33	7	5U	110	5U	280
2-03	529	42	15	5U	5U	67	5	400
5-03								

Volatiles: micrograms per liter (ug/l)
Well ID: Monitoring Well #89-12

Date	1,1-dichloroethene	1,1,1-trichloroethane	tetrachloroethene
11/94	400	840	1600
2/95	220	250	610
5/95	360	520	500
8/95	26	50	200
11/95	10J	7J	56J
2/96	19	45	250
5/96	32	88	7
8/96	87	200	14
11/96	90D	240D	1000D
2/97	180	200D	390D
5/97	68	120	290
8/97	32	100	500
11/97	180	260	1300
2/98	310	450	1700
5/98	79	130	280
8/98	45	88	270J
11/98	44	130	220
2/99	15	9	47
5/99	63	270	360
8/99	28	72	130
11/99	40	110	250
2/00	13	20	35
5/00	20	57	60
8/00	35	48	230
11/00	14	42	130

DATE	11-DCE	111-TCA	PCE
02/01	11	31	88
05/01	33	66	140
08/01	75	120	370
11/01	54	120	170
02/02	24	23	70
05/02	18	10	32
06/02	19J	11J	28J
08/02	78J	84J	260J
11/02	74	110	280
02-03*	42	67	400
05-03	50	45	180

Lindsay well 89.12
EPA reviewed the historical data base for the levels of VOCs present in this well initially. In 1992, the PCE level varied from 860-6400 ug/l. In 1993, the PCE varied from 2000-6000 ug/l. In 1994, the levels were between 600-1600 ug/l. The full scale SVE system began on March 15, 1995, for Areas 1 and 2. Well depth is 72.5' deep considered to be an upper aquifer well with a 10' well screen. Initiated a treatability study in May 1998 pumping this well at 60 gallons per minute. The EPA and NDEQ evaluated the modification to the ground water remediation system after the August 1998 quarterly sampling effort and determined that utilizing this well as the source remediation extraction well and the use of irrigation during the summer growing season.

Since May 1998, monitoring/extraction well 89-12 removed the following pounds of VOCs from the aquifer:

date	ug/l VOCs	million gallons	liters to gallons	#454 to lbs.
5-1998	513	2.4	3.7854	10.3
8-998	437	7.5	3.7854	27.3
11-1998	411	6.2	3.7854	21.3
2-1999	71	0		
5-1999	708	5.7	3.7854	33.6
8-1999	242	7.1	3.7854	14.3
11-99	416	4.7	3.7854	16.3
2-2000	68	1.7	3.7854	0.96
5-2000	142	7.9	3.7854	9.4
8-2000	341	5.5	3.7854	15.64
11-2000	186	3.12	3.7854	4.84

2-2001	130	1.31	3.7854	1.42
5-2001	251	5.97	3.7854	12.5
8-2001	647	6.91	3.7854	37.3
11-2001	379	4.83	3.7854	15.3
2-2002	117	0.72	3.7854	0.7
5-2002	60	0.008	3.7854	0.004
8-2002	468	2.59	3.7854	10.11
11-2002	504	0.131	3.7854	0.55
2-2003	529	0	3.7854	0

Total pounds of VOCs removed from aquifer since May 1998 is 1225.5 pounds in 74.3 million gallons of water removed to February 2003.

In FY97, 102 pounds of VOCs were removed in 143,000,000 gallons of ground water. 129,000,000 gallons of water were reused as irrigation water.

In January 1998 to November 1999, AOIW was pumped for 32,700 gallons of ground water. OIW was used to remove 30,620,544 gallons which contained 10 ug/l of PCE or 2.6 pounds of VOCs. Bellar north well removed 4.6 million gallons of water. Bellar south removed 22.4 million gallons of ground water and the Priester irrigation well removed 19.8 million gallons of ground water for a total of 46,8 million gallons of ground water used for irrigation. These wells were not sampled for VOCs so EPA has no way to determine the amount of VOCs contained in the contaminated ground water. 59 pounds of VOCs were removed from 89-12 well in 1998. In 1999, 89-12 well removed 64.2 pounds of VOCs. 26 pounds were removed in 2000. The OIW well contained 33 ug/l of VOC in Feb. 2000 and 70 ug/l in August, 2000. 94 million gallons of ground water were used for irrigation in the summer of 2000.

Lindsay is no longer tracking the amount of irrigation water removed from the irrigation wells surrounding the Lindsay facility. 2000-2002 have been drought years in and around Lindsay and it is believed that ground water used for irrigation during the growing season was extensive. Lindsay has also not analyzed the levels of VOCs in the irrigation wells so EPA can not evaluate/estimate the amount of VOCs removed from the irrigation wells.

During the week of September 17, 2001, a treatability study was conducted at Lindsay where several pounds of HRC, a food grade poly-lactic acid was injected into the aquifer close to the contaminants. The November 2001 results were the first results collected from this effort and reported to EPA. The EPA has continued to monitor the ground water monitoring results and the HRC work has not appeared to assist in the remediation of the plume present at the site.

The November 2002 results indicate that the levels of VOCs have rebounded in this well. During 2002, this well was not pumped as much as in the past due to mechanical failure. Lindsay had started the well in March 2002 and it was pumping when a winter storm moved in and froze the system and broke the irrigation system. Lindsay requested that EPA and NDEQ consider using the water from this well as crop irrigation water. The NDEQ responded that it was fine with that suggestion and Lindsay began operating this system for crop irrigation. This

was not implemented until much later in the season. Lindsay had mechanical problems with the irrigation system used for disposal and they installed a new system in the spring 2003. The startup date for the operation of MW89-12 was May 2003.

Volatiles: micrograms per liter (ug/l)
Well ID: Monitoring Well #89-14

Date	1,1-dichloroethene	1,1,1-trichloroethane	tetrachloroethene
11/94	43	71	22
2/95	47	71	23
5/95	28	47	17
8/95	13	21	8
11/95	49J	61J	21J
2/96	19	28	14
5/96	13	18	14
8/96	76	120	43
11/96	24	58	18
2/97	27	47	19
5/97	21	31	18
8/97	38	92	34
11/97	43	57	28
2/98	49	94	43
5/98*	41	45	35
8/98	43	26	27J
11/98	25	24	22
2/99	20	21	19
5/99	32	30	24
8/99	36	36	21
11/99	48	50	32
2/00	32	35	21
5/00	40	54	20
8/00	31	44	18
11/00	5U	6	5

DATE	11-DCE	111-TCA	PCE
02/01	9	10	8
05/01	8	10	8
08/01	6	9	7
11/01	5U	8	5
02/02	5U	5U	6
05/02	5U	5	7
08/02	12J	19J	9J
11/02	8	15	11
02-03	5U	5U	6
05-03	5U	5U	8

This well is 44.5 feet deep with a 10' well screen. It is considered to be a "perched sand channel well." Lindsay well 89-14.

Starting the week of September 17, 2001, Lindsay initiated a treatability study using HRC, a food-grade poly-lactic acid to determine if the HRC would reduce the amount of chlorinated solvents remaining in the aquifer. The November 2001 results are the first results EPA received from Lindsay since the injection.

Volatiles: micrograms per liter (ug/l)
Well ID: Monitoring Well #89-14

Date	1,1-dichloroethene	1,1,1-trichloroethane	tetrachloroethene
11/94	43	71	22
2/95	47	71	23
5/95	28	47	17
8/95	13	21	8
11/95	49J	61J	21J
2/96	19	28	14
5/96	13	18	14
8/96	76	120	43
11/96	24	58	18
2/97	27	47	19
5/97	21	31	18
8/97	38	92	34
11/97	43	57	28
2/98	49	94	43
5/98*	41	45	35
8/98	43	26	27J
11/98	25	24	22
2/99	20	21	19
5/99	32	30	24
8/99	36	36	21
11/99	48	50	32
2/00	32	35	21
5/00	40	54	20
8/00	31	44	18
11/00	5U	6	5

DATE	11-DCE	111-TCA	PCE
02/01	9	10	8
05/01	8	10	8
08/01	6	9	7
11/01	5U	8	5
02/02	5U	5U	6
05/02	5U	5	7
08/02	12J	19J	9J
11/02	8	15	11
02-03	5U	5U	6
05-03	5U	5U	8

This well is 44.5 feet deep with a 10' well screen. It is considered to be a "perched sand channel well." Lindsay well 89-14.

Starting the week of September 17, 2001, Lindsay initiated a treatability study using HRC, a food-grade poly-lactic acid to determine if the HRC would reduce the amount of chlorinated solvents remaining in the aquifer. The November 2001 results are the first results EPA received from Lindsay since the injection.

Volatiles: micrograms per liter (ug/l)
Well ID: Monitoring Well #89-15

Date	1,1-dichloroethene	1,1,1-trichloroethane	tetrachloroethene
11/94	53	98	45
2/95	63	100	50
5/95	85	130	55
8/95	88	190	95
11/95	17J	28J	13J
2/96	47	83	41
5/96	56	100	48
8/96	34	62	33
11/96	65	97	48
2/97	40	66	32
5/97	28	42	18
8/97	140	330	140
11/97	50	70	38
2/98	28	46	19
5/98*	42	59	29
8/98	83	130	73J
11/98	57	72	39
2/99	140	170	92
5/99	6	25	15
8/99	43	55	30
11/99	54	74	44
2/00	110	140	82
5/00	97	140	71
8/00	230	520	170
11/00	180	220	160

DATE	11-DCE	111-TCA	PCE
02/01	130	180	100
05/01	59	81	43
08/01	280	450	270
11/01	140	200	110
02/02	110	130	93
05/02	67	89	56
08/02	120J	290J	170J
11/02	130	180	110
02-03	46	51	38
05-03	58	76	53

This well is 63.1 feet deep with a 10' well screen and is considered to be an "upper aquifer" well. Lindsay well 89-15.

In September 17, 2001, Lindsay initiated a treatability study using HRC, a food-grade poly-lactic acid to determine if the HRC would be effective in reducing the levels of VOC present in the aquifer. The analytical results from the Nov. 01 sampling are the first results EPA received from the injection.

Monitoring Well # 89-15

Date	total VOCs	11-DCE	11-DCA	12-DCE	12-DCA	111TCA	TCE	PCE
MCLs, ug/l		7	no standard	170	5	200	5	5
11-97	158	50	5U	5U	5U	70	5U	38
2-98	93	28J	5U	5U	5U	46J	5U	19J
5-98	130	42	5U	5U	5U	59	5U	29
8-98	293	83	7	5U	5U	130	5U	73J
11-98	168	57	5U	5U	5U	72	5U	39
2-99	409	140	7	5U	5U	170	5U	92
5-99	46	6	5U	5U	5U	25	5U	15
8-99	128	43	5U	5U	5U	55	5U	30
11-99	172	54	5U	5U	5U	74	5U	44
2-00	338	110	6	5U	5U	140	5U	82
5-00	315	97	7	5U	5U	140	5U	71
8-00	995	230	56	19	5U	520	5U	170
11-00	594	180	25	9	5U	220	5U	160
2-01	430	130	14	6	5U	180	5U	100
5-01	183	59	5U	5U	5U	81	5U	43
8-01	1168	280	89	73	5U	450	6	270
11-01	483	140	20	13	5U	200	5U	110
2-02	340	110	7	5U	5U	130	5U	93
5-02	212	67	5U	5U	5U	89	5U	56
8-02	744	180J	54J	50J	5UJ	290J	5UJ	170J
11-02	496	130	36	40	5U	180	5U	110
2-03	135	46	5U	5U	5U	51	5U	38
5-03								

Volatiles: micrograms per liter (ug/l)
Monitoring Well 92-3A

Date	1,1-dichloroethane	1,1,1-trichloroethane	tetrachloroethene
2/98			
5/98	6	46	28
8/98	5U	42J	14
11/98	19	83	38
2/99	6	67	30
5/99	25	120	54
8/99	5u	14	6
11/99	15	74	30
2/00	9	38	16
5/00	6	88	32
8/00	5U	52	22
11/00	9	110	46
02/01	7	130	49
05/01	11	120	42
08/01	5U	75	32
11/01	12	100	42
02/02	16	110	48
05/02	67	89	56
08/02	10	77J	23
11/02	6	63	28
02-03	5	65	29
05-03	13	81	37

Volatiles: micrograms per liter (ug/l)
Well ID: Monitoring Well #92-3B

Date	1,1-dichloroethene	1,1,1-trichloroethane	tetrachloroethene
11/94	22	75	37
2/95	44	140	64
5/95	78	270	95
8/95	21	68	31
11/95	24J	78J	36J
2/96	37	120	50
5/96	45	170	66
8/96	37	160	68
11/96	56	170	73
2/97	120	370D	160
5/97	95	390	140
8/97	59	170	73
11/97	36	140	66
2/98	59	210	98
5/98*	48	160	72
8/98	46J	150J	68J
11/98	44	110	43
2/99	26	87	35
5/99	58	180	73
8/99	18	92	39
11/99	26	74	30
2/00	16	100	41
5/00	5U	14	7
8/00	7	42	21
11/00	10	34	15

DATE	11-DCE	111-TCA	PCE
02/01	5U	26	12
05/01	4.7	17	7.7
08/01	5U	17	9
11/01	5U	16	8
02/02	5U	10	6
05/02	5U	11	6
08/02	5U	12J	5U
11/02	5U	9	6
02-03	5U	5	5U
05-03	5U	6	5U

This well is screened in the bottom of the aquifer.
(Lindsay well 92.3B)

Lindsay Manufacturing
GROUND WATER CONCENTRATIONS
Micrograms/liter
OIW WELL

Date	1,1-DCE	111-TCA	PCE
8/94	42	41	34
11/94	31	35	35
2/95	29	36	43
5/95	26	28	38
8/95	47	100	64
11/95	-	-	-
2/96	36	62	24
4/96	14	20	15
8/96	12	18	9
11/96	7	7	7
2/97	19	29	17
5/97	12	5U	20
8/97	34	54	22
11/97	7	7	7
2/98	19	33	30
5/98	5U	5U	6
11/98	5	5	6
2/99	22	5	33
5/99	5U	5U	5U
8/99	5U	5U	10
11/99	5U	5U	10
2/00	12	5U	21
5/00	18	5U	26

8/00	22	29	19
11/00	7	7	8
2/01	14	5	24
5/01	26	9	44
8/01	66	100	56
11/01	28	35	23
02/02	20	9	32
05/02	18	7	33
08/02	120J	290J	110J
11/02	35	59	35
02-03	13	11	16
05-03	10	6	17

In March 15, 1995, the SVE system started for both Area 1 and Area 2. In August 1, 1995, OIW well down, pumping from only AOIW and TIW (24.7 million gallons from AOIW and 46.2 million gallons from TIW) in October and November 1995. In the AOIW well, the pH ranged from 5.8 to 6.65, this seems low. Extraction system shut down on November 20, 1996. Restarted on February 3, 1997, with OIW pumping only. The OIW well had not been pumped during April-September 1997. The ground water from OIW in the November 1997 sample had 17 ug/l of 11-DCE; 7ug/l of TCA and 25ug/l of PCE. This well has a 40' screened interval and is 95' deep.

Lindsay Manufacturing
GROUND WATER CONCENTRATIONS
Micrograms/liter
AOIW WELL

Date	1,1-DCE	111-TCA	PCE
8/94	64	280E	360E
11/94	35	48	50
2/95	26	81	120
5/95	33	130	160
8/95	28	76	100
11/95	48J	140J	190J
2/96	34	74	97
5/96	5U	5U	6
8/96	17	37	66
11/96	16	36	67
2/97	5U	5U	5U
5/97	5U	5U	5U
8/97	30	56	140
11/97	16	36	67
2/98	5U	5U	5U
5/98	5U	5U	5U
8/98	5U	5U	5U
11/98	5U	5U	5U
2/99	5U	5U	5U
5/99	5U	5U	5U
8/99	5U	5U	5U
11/99	5U	5U	5U
2/00	5U	5U	5U

5/00	5U	5U	5U
8/00	5U	5U	5U
11/00	5U	5U	5U
2/01	5U	5U	5U
5/01	1U	1.8	1U
8/01	5U	5U	5U
11/01	5U	5U	5U
2/02	5U	5U	5U
5/02	5U	5U	5U
08/02	5U	5U	5U
11/02	5U	5U	5U
02-03	5U	6	5U
05-03	5U	5U	5U

In March 15, 1995, the SVE system for Areas 1 and 2 started. In August 1, 1995, the OIW well was down. Pumping only AOIW (24.7 million gallons) and TIW (46.2 million gallons) during shut down for OIW. Extraction system shut down on November 20, 1996, and restarted on February 3, 1997, with OIW well pumping only. The AOIW well pumped during April, July, August, and September 1997. In July-Sept 1997, extracted 15.8 million gallons of water. In November, 1997, the AOIW well had 6 ug/l of 11-DCE; 7ug/l of TCA and11 ug/l of PCE. This well is 130' deep with a 30' screened interval.

Started using only MW89-12 was used for extraction purposes only in 1998. Lindsay injected HRC at cell 1 and cell 2 in September 2001.

Beller's Stock Well
micrograms per liter (ug/l)

Date	11-DCE	111-TCA	PCE
2-99	1U	1	1U
5-99	1U	2	1
8-99	1U	2	2
9-02	21	29	65
11-02	20	30	86

Lindsay Manufacturing
GROUND WATER CONCENTRATIONS
Micrograms/liter
Beller Irrigation WELL

Date	1,1-DCE	111-TCA	PCE
MAX 1989	78	450	91
MAX 1990	160	570	130
MAX 1991	230	1000	210
MAX 1992	54	150	47
MAX 1993	31	25	21
8/94	12	27	11
11/94	4	4	3
2/95	5U	5U	5U
5/95			
8/95	76	300	92
11/95	120	430	130
2/96	13	39	15
5/96	2	4	2
8/96	16	43	16
11/96	1U	1U	1U
2/97	1U	1U	1U
5/97	9	25	9
8/97	40	110	37
11/97	1U	1U	1U
2/98	1U	1U	1U
5/98	1U	1U	1U
8/98	1U	1U	1U
11/98	1U	1U	1U
2/99	1U	1U	1U

5/99	1U	1U	1U
8/99	1U	1U	1U

In March 15, 1995, the SVE system for Areas 1 and 2 started. In August 1, 1995, OIW well was down. Pumping only AOIW (24.7 million gallons) and TIW (46.2 million gallons) during shut down for OIW. Extraction system shut down on November 20, 1996, and restarted on February 3, 1997, with OIW well pumping only. Pumped 36.9 million gallons from this well during the April-September 1997 period.

Beller's Domestic Supply Well
micrograms per liter

DATE	11-DCE	111-TCA	PCE
5-98	1U	1U	1U
8-98	7	16	16
11-98	1U	1U	1U
2-99	1U	1U	1U
5-99	1U	1U	1U
8-99	1U	1U	1U
11-99	NOT	SAMPLED	
2-00	NOT	SAMPLED	
5-00	NOT	SAMPLED	
8-00	NOT	SAMPLED	
11-00	NOT	SAMPLED	
2-01	NOT	SAMPLED	
5-01	NOT	SAMPLED	
8-01	NOT	SAMPLED	
11-01	NOT	SAMPLED	
3-02	NOT	SAMPLED	
5-02	NOT	SAMPLED	
8-02	NOT	SAMPLED	
9-02	1.4	1.8	4.2
11-02	2.2	2.8	1.2
2-03	2.3	3.0	9.3

Priester House Well
Volatiles (ug/l) - Before

Date	1,1-dichloroethene	1,1,1-trichloroethane	tetrachloroethene
8/90	1 or 5 U	1 or 5 U	1 or 5U
8/93	1 or 5 U	1 or 5U	1 or 5U
11/93	1 or 5U	1 or 5U	1 or 5U
2/94	1 or 5 U	2 J	1 or 5U
8/94	1 or 5U	3J	2J
11/94	1 or 5U	6	1 or 5U
2/95	5U	5U	5U
2/98	5U	11	10
5/98	6	13	13
11/98	8	18	14
02/99	7	14	14
05/99	14	32	31
08/99	20	40	31
11/99	28	56	44
1/00	30	59	37
02/00	49	94	55
03/00	56	130	65
04/00	65	140	62
05/00	75	170	69
08/00	26	54	32
11/00	15	33	20
02/01	22	52	26
05/01	49	110	46
08/01	33	63	32

11/01	38J	77J	37J
02/02	51	94	49
05/02	80	130	63
08/02	30J	54J	30J
09/02	29	53	24
11/02	27	50	28
02-03	24	47	27
05-03	40	71	41

In August 1999, several private wells were sampled and none of the domestic wells were found to exceed the MCLs for VOCs outside of the Priester well. The MCL for TCA is 200 ug/l so even though there is a "high" level of TCA present, to date, the MCLs have not been exceeded. A treatment system was installed on the Priester well and ground water samples representing both the before treatment and after treatment are collected and analyzed. The EPA will be conducting a 5-year review during 2003 to determine the effectiveness of the HRC injection as well as the use of irrigation as a remediation alternative using M89-12.

During 2002, this area experienced limited rainfall and the ground water levels were affected. This well also experienced several problems in complying with the MCLs and Lindsay had tested the quality of the ground water several times since they had breakthrough several times.

In October 2002, Lindsay tested the domestic supplies at the following locations: Doug Beller, Ron Pfeifer and the old Moravec location. All were found to be free of contamination at the 1ug/l level. In November 2002, Lindsay tested the following domestic locations: Priester's, and Bellers. Both wells were contaminated above MCLs. In December 2002, Priester's drinking water supply was tested three times and the Old Moravec well was tested as was monitoring well MW89-11B. These wells were found to be free of contamination at the 1 ug/l except for MW89-

11B which contained PCE at 1.4 ug/l. As of December 2002, Lindsay believed that these problems had been resolved and the system at the Priester's was operating properly. In January 2003, the drinking water at Lindsay was tested two times and was found not to contain any contamination above 1 ug/l. In February 2003, the following domestic supplies were tested: Beller's before, Priester's before and drinking water, Ben Pfiefer's, Ed Luetkenhaus, and Ron Pfiefer. Contamination was present in Beller's and Priester's supply. All others were found to be free of contamination above the detection limit of 1 ug/l. Priester's after treatment was found to be free of contamination at the 1 ug/l level. Priester's drinking water was further tested in March 2003 and was found to be free of contamination above 1 ug/l.

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

LINDSAY MANUFACTURING
COMPANY
**ENHANCED GROUNDWATER
REMEDIATION PROGRESS
REPORT
PERIOD COVERING APRIL 1, 1997
TO
SEPTEMBER 30, 1998**

Prepared for:
**U.S. Environmental Protection Agency
Region VII**

Submitted by:
**Dames & Moore, Inc. for
Lindsay Manufacturing Company
November 9, 1998**

DAMES & MOORE

A DAMES & MOORE GROUP COMPANY

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November 9, 1998

Ms. Diane Easley
EPA Project Coordinator
United States Environmental Protection Agency
Superfund Division
726 Minnesota Avenue
Kansas City, Kansas 66101

Enhanced Groundwater Remediation
Progress Report
U.S. v. Lindsay Manufacturing Company
C.A. 8:92-00015

Dear Ms. Easley:

Lindsay Manufacturing Company is pleased to submit this Enhanced Groundwater Remediation Progress Report covering the period from April 1 to September 30, 1998. This report includes the summaries of Consent Decree items which have been completed or undertaken during the period from April 1 to September 30, 1998 and the tasks to be completed or undertaken during the next reporting period of October 1, 1998 to March 31, 1999.

Progress in enhanced groundwater remediation has been made and the aquifer restoration is near completion. As such, the final stage of remediation has been changed to a resource sustaining effort. These methods have been tested and found to have merit. These include the application of pumped water to irrigation of crops. This modification to the remediation system was proposed to the EPA and NDEQ by Lindsay in a letter dated September 25 and approved by the EPA and NDEQ in a letter dated November 2, 1998. Based on a May to August, 1998 treatability study, monitoring well MW89-12 was converted to a low-volume extraction well. Continued use of MW89-12, as well as seasonal extraction via regional irrigation wells, will continue in order to capture the residual organics in the aquifer. The OIW will be kept ready to pump in the event of a downward shift in pH. If required, the OIW will be pumped for 30 days or less prior to the irrigation season.

Dames & Moore recommends a combination of adjustments in the final stage of aquifer restoration, including: low-volume interception on property through converted monitoring well MW89-12 and monitoring of the ongoing seasonal dispersion of residuum down gradient by the existing irrigation wells. Dames & Moore recommends the continued land application of recovered groundwater during the irrigation season with ongoing monitoring as the final stage of remedial action.

If you have any questions regarding this Enhanced Groundwater Remediation Progress Report, please do not hesitate to call me at your convenience.

Very truly yours,

DAMES & MOORE, INC.

Roy W. Elliott
Project Coordinator

TABLE OF CONTENTS

TABLES

FIGURES

ATTACHMENT

LINDSAY MANUFACTURING COMPANY
ENHANCED GROUNDWATER REMEDIATION PROGRESS REPORT
PERIOD COVERING APRIL 1, 1998 to SEPTEMBER 30, 1998

1.0 INTRODUCTION

Lindsay Manufacturing Company is pleased to submit this Enhanced Groundwater Remediation Progress Report covering the period from April 1 to September 30, 1998. This report covers the second and third calendar quarters of 1998 and presents groundwater elevations for the months of April through September 1998; a summary of groundwater recovery and treatment during the period; and the analytical results from the thirty-eighth and thirty-ninth quarterly rounds of groundwater samples. This report includes the summaries of Consent Decree items which have been completed or undertaken during the period from April 1 to September 30, 1998 and the tasks to be completed or undertaken during the next reporting period of October 1, 1998 to March 31, 1999. In addition, conclusions and recommendations are offered for the final stage in aquifer remediation.

All items scheduled for completion/submission during this reporting period have been completed on or before the scheduled compliance dates and no unplanned or unresolved delays were encountered.

Items accomplished in this reporting period include the following:

Items	Date Submitted or Performed
Submission of Enhanced Groundwater Remediation Progress Report (XI.27.g)	November 9, 1998
Collection of Thirty-Eighth Quarterly Groundwater Samples (XI.21.g)	May 10-13, 1998
Collection of Thirty-Ninth Quarterly Groundwater Samples (XI.21.g)	August 17-19, 1998

Items scheduled for completion during the next reporting period include the following:

Items	Scheduled Date
Lindsay letter, Modifications to Operation and Maintenance for the Ground Water System	September, 1998
Submission of Enhanced Groundwater Remediation Progress Report (XI.27.g)	April, 1999
Collection of Fortieth Quarterly Groundwater Samples (XI.21.g)	November, 1998
Collection of Forty-First Quarterly Groundwater Samples (XI.21.g)	February, 1999

2.0 SUMMARY OF REMEDIAL PUMPING

Monthly summaries of total gallons pumped from each well and the range of pH measured in each well are presented in Table 1. Daily pumping records including the volume, pH and temperature of groundwater pumped are available upon request.

During the thirty-eighth and thirty-ninth quarters, monitor well MW89-12 was the only well operated within the interceptor system. MW89-12 operated between May 29 and September 30, 1998, with only short shutdowns due to mechanical or power problems.

This schedule was operated in order to enhance remediation by intercepting residuum downgradient of the OIW and sand channel while the regional agricultural irrigation wells were pumping during the irrigation season to further attenuate downgradient residual contamination as recommended in our April 15, 1997 groundwater remediation report.

The pH in the water of the OIW interceptor well water ranged from 6.17 S.U. to 6.45 S.U. during sampling rounds (Table 1). The pH in the water of the AOIW interceptor well water ranged from 6 S.U. to 6.51 S.U. during sampling rounds (Table 1). These ranges are similar to previous quarters and exhibit a gradual shift upward toward background.

Seasonal well pumping and crop irrigation continued during the summer aiding in the off property attenuation of the residual organics and metals.

3.0 GROUNDWATER ELEVATIONS

Groundwater elevations were measured and recorded in 8 select wells and piezometers during the thirty-eighth and thirty-ninth quarterly sampling. A tabulated summary of the water level measurements is presented in Table 2. Due to the approved decreased water level data collection, sufficient data for creating potentiometric surface maps of the sand and gravel aquifer was not available. However, hydrographs of two wells, MW89-13 (in the Sand Channel) and MW89-15 (Sand and Gravel Aquifer) were created to compare current water levels to historical water levels during the remediation program. These hydrographs are included as Figures 1 and 2. The water levels observed in the monitor wells are consistent with previous water levels, accounting for pumping and seasonal fluctuations. These hydrographs and other water level data will be updated as further sampling round data is received, but will not be included in later reports unless significant departures from historical water levels are noted. The tables will be discontinued after this report for efficiency. Records will be kept and can be supplied upon request if required.

4.0 SUMMARY OF QUARTERLY GROUNDWATER MONITORING

A summary of wells sampled and the analytical program for this period is presented in Table 3. Since the approved limited number of monitoring wells represent principally remediation control monitoring wells, isoconcentration maps could not be prepared. Hence, the analytical data and field measurements of indicator parameters are presented in tabular form and are discussed in the following text. Comparisons to past quarterly sampling results are discussed where useful in understanding the enhanced remediation.

A significant finding is the control of the water quality in the aquifer. The areas of exceedence of cleanup criteria are defined along an axis from source area to the downgradient terminus. No significant deviations occurred in 1998 in this trend, evidence of the control of the ambient flow of groundwater and capture by interceptor and irrigation wells along this axis. This includes data collected after the initiation of interception pumping from MW 89-12, which appears to be containing residuum from the vicinity upgradient of the AOIW.

The Preister house and stock wells have been added to quarterly sampling and analysis (Figure 3). Lindsay Manufacturing has installed treatment on the house well water. Sampling will be pre- and post-treatment and will continue until the Maximum Contaminant Levels have been achieved. The results of the sampling will be reported with the required quarterly reports. There are no records available for the Preister house or stock well, however the irrigation well is 94 feet deep with 40 feet of screen in the sand and gravel aquifer and operates at 1,500 gallons per minute. For more information, refer to Appendix I of the Remedial Investigation.

4.1 FIELD MEASUREMENTS

Field specific conductivity, pH and temperature measurements collected during quarterly sampling events are summarized in Tables 4 and 5.

4.1.1 Perched Sand Channel Results

Field pH values measured in the samples collected from monitoring wells screened in the perched sand channel were 6.49 and 7.11 Standard Units (S.U.) for the MW89-13 sample and 5.73 and 5.84 S.U. for the MW89-14 sample. The field pH reported for MW89-13 is similar to background levels and MW89-14 was similar to previous quarters. The pH distribution in groundwater in the sand channel is similar to that observed in the previous quarters, with the lowest pH values occurring toward the northern end of the sand channel.

Field specific conductivity values reported for groundwater samples collected from wells screened in the perched sand channel were 835 and 640 umhos/cm for MW89-13 and 1026 and 1220 umhos/cm for MW89-14. The field conductivities reported for MW89-13 in the samples were consistent with the November and February samples (690 and 640 umhos/cm), and are slightly higher than conductivities seen in previous quarters (typically less that 600 umhos/cm). The field conductivity reported for MW89-14 during the thirty-eighth and thirty-ninth quarters were consistent with the February sample (1215 umohs/com) and are consistent with to slightly elevated from samples collected during the thirty-fourth and thirty-fifth quarters (1045 and 955 umhos/cm). The level of specific conductivity, as expected, is greatest in the northern end of the sand channel and declines toward the south.

4.1.2 Sand and Gravel Aquifer Results

Field pH values measured in samples collected from wells screened in the sand and gravel aquifer ranged from 5.89 S.U to 7.11 S.U. with the lowest pH values primarily in zones adjacent to P-9 (5.89 S.U.), the OIW (6.17 S.U.), and the AIOW (6.0 S.U.). This pattern is similar to previous quarters.

Field specific conductivity values reported for groundwater samples collected during the thirty-eighth and thirty-ninth quarters from wells screened in the sand and gravel aquifer ranged from 470 umhos/cm at the TIW to 1500 umhos/cm at MW92-3B and MW89-15 with the highest conductivity values primarily in zones adjacent to MW92-3B (1321 and 1500 umhos/cm), MW89-15 (1500 and 952 umhos/cm), and MW89-12 (1030 umhos/cm and 1109 umhos/cm). This pattern is comparable to previous quarters. Conductivity in the lower portion of the aquifer at MW92-3B is consistent with the thirty-sixth and thirty-seventh quarters (1610 and 1424 umhos/cm), which is consistent with the aquifer stress by local irrigation well discharges.

4.2 INORGANIC LABORATORY RESULTS

Inorganic analytical laboratory results for the monthly and quarterly sampling events are summarized in Table 4. Quality Assurance/Quality Control (QA/QC) review and validation are provided in the attachment to this report and any qualifications are shown by flagged notations in Table 4. In general, inorganic results were found to be acceptable.

4.2.1 Perched Sand Channel Inorganic Results

Zinc concentrations (23.4 mg/L) detected in the groundwater collected from the perched sand channel (monitoring well MW89-14) during the thirty-eighth quarter were consistent with concentrations noted during the thirty-sixth and thirty-seventh quarters (11.9 mg/L and 21.4 mg/L, respectively). Sulfate concentrations (530 mg/L and 430 mg/L) detected in the groundwater during the thirty-eighth and thirty-ninth quarters were consistent with concentrations detected during the previous quarters (220 mg/L and 440 mg/L). Concentrations decreased as water levels declined and increased as water levels rose. Zinc and sulfate concentrations detected during the thirty-eighth and thirty-ninth quarters were above the respective MCLs (5.0 mg/L and 250 mg/L).

Iron concentrations detected during the thirty-eighth quarter (3.4 mg/L) increased from the thirty-seventh quarter (2.47 mg/L), however, concentrations were similar to previous quarters. Concentrations were above the MCL (0.3 mg/L).

Groundwater collected from MW89-14 during the thirty-ninth quarter was not analyzed for metals. Groundwater collected from MW89-13 during the thirty-eighth and thirty-ninth quarters was not analyzed for inorganic compounds, in accordance with the alternate year sampling schedule outlined in the May, 1998 modification of the Statement of Work.

4.2.2 Sand and Gravel Aquifer Inorganic Results

During the thirty-eighth and thirty-ninth quarters, samples collected for inorganic analyses were collected only from MW89-15, MW87-3, and Beller Domestic, Stock, and Irrigation wells.

Zinc concentrations detected in samples from wells screened in the sand and gravel aquifer ranged from 0.907 mg/L at MW87-3 to 12.3 mg/L at MW89-15. For the thirty-eighth and thirty-ninth quarters, zinc concentrations detected were below the secondary MCL (5 mg/L) with the exception of groundwater collected from MW89-15.

Zinc detected at this well was 12.3 mg/L during the thirty-eighth quarter. Metals were not analyzed from the sample collected at MW89-15 during the thirty-ninth quarter.

Zinc at background levels was detected in the Beller Domestic (filtered and unfiltered) and the Beller Stock wells. Concentrations were below the MCL. Zinc concentrations detected in the Beller Irrigation well during the thirty-eighth quarter (1.13 mg/L) were similar to concentrations detected during the thirty-seventh quarter (1.06 mg/L). Concentrations were below the MCL for zinc.

Sulfate concentrations detected during the thirty-eighth and thirty-ninth quarters ranged from 49 mg/L at MW87-3 to 680 mg/L at MW89-15. Sulfate detected in sample collected from MW89-15 (130 mg/L) during the thirty-eighth quarter was below the MCL (250 mg/L) but increased and exceeded the MCL during the thirty-ninth quarter (680 mg/L). Sulfate detected in samples collected from the Beller Domestic, Stock, and Irrigation wells ranged from 20 to 41 mg/L, below the MCL.

Cadmium was not detected in any of the wells sampled, including the Beller Domestic (filtered and unfiltered), Stock, or Irrigation wells, during the thirty-eighth and thirty-ninth quarters.

Chromium was detected during the thirty-ninth quarter in the groundwater sample collected from MW87-3. The concentration detected was 0.009 mg/L, below the MCL (0.05 mg/L). Chromium was not detected in the Beller Domestic, Stock, or Irrigation wells.

Iron was detected in the groundwater sample collected from MW89-15 during the thirty-eighth quarter (1.67 mg/L) and in the groundwater sample collected from MW87-3 during the thirty-ninth quarter (0.23 mg/L). The concentration detected in MW89-15 was above the MCL (0.3 mg/L). The concentration detected in MW87-3 was below the MCL. Iron was not detected in groundwater samples collected from the Beller Domestic, Stock, and Irrigation wells.

Groundwater samples collected from MW87-3 and the Beller Domestic, Stock, and Irrigation wells were analyzed for lead. Lead (0.002 mg/L) was detected during the thirty-ninth quarter in MW87-3. Lead was detected in groundwater samples collected from Beller Domestic well (prior to filtration, 0.005 mg/L), Beller Stock well (0.001 mg/L), and the Beller Irrigation (0.004 mg/L) well. Lead concentrations detected were below the MCL (0.05 mg/L).

4.3 ORGANIC LABORATORY RESULTS

Organic analytical laboratory results for the monthly and quarterly sampling events are summarized in Table 5. Quality Assurance/Quality Control (QA/QC) review and validation are provided in the attachment to this report and any data qualifications are shown by flagged notations in Table 5. In general, organic results were found to be acceptable.

4.3.1 Perched Sand Channel Organic Results

The three predominant organic compounds detected in groundwater samples collected during the thirty-eighth and thirty-ninth sampling rounds from wells screened in the perched sand channel are the same compounds detected in previous quarters: 1,1-dichloroethene (1,1-DCE), 1,1,1-trichloroethane (1,1,1-TCA), and tetrachloroethene (PCE). The groundwater sample collected from MW89-13 contained 19 ug/L and 23 ug/L PCE during the thirty-eighth and thirty-ninth quarters. These concentrations were comparable to concentrations detected during the previous two quarters (13 ug/L and 17 ug/L, respectively). The results for MW89-14 were 41 ug/L and 43 ug/L of 1,1-DCE, 45 ug/L and 56 ug/L of 1,1,1-TCA, and 35 ug/L and 27 ug/L of PCE. The concentration of total organics in groundwater samples collected from MW89-13 (23 ug/L) and MW89-14 (126 ug/L) during the thirty-ninth quarter were consistent with concentrations detected during the thirty-seventh quarter (17 ug/L and 186 ug/L, respectively).

4.3.2 Sand and Gravel Aquifer Organic Results

Organic compounds were detected in 8 of the 13 wells sampled during the thirty-eighth quarter and in 8 of the 14 wells sampled during the thirty-ninth quarter. Organic compounds were detected in groundwater samples collected from MW87-3, MW89-12, MW89-15, MW92-3A, MW92-3B, the OI Well, Preister's House well, and P-9 (Figure 3). Additionally, samples were collected in June 1998 from Beller's Irrigation well and Preister's House, Stock, and Irrigation wells. Organic compounds were detected only in the sample collected from Preister's House well.

In monitoring wells screened in the sand and gravel aquifer, concentrations of 1,1-DCE ranged from not detected to 83 ug/L at MW89-15. 1,1-DCE was detected in groundwater samples collected during the thirty-eighth and thirty-ninth quarters from wells MW89-12 (79 and 45 ug/L), MW89-15 (42 and 83 ug/L), MW92-3B (48 and 46 ug/L), and Preister's House well (6 ug/L and 7 ug/L). Additionally, 1,1-DCE was detected in the OI Well (30 ug/L) during the thirty-ninth quarter, MW87-3 (7 ug/L) during the thirty-eighth quarter, MW92-3A (6 ug/L) during the thirty-eighth quarter, P-9 (25 ug/L) during the thirty-eighth quarter, and Preister's House well (7 ug/L) in June 1998. The concentration of 1,1-DCE detected in most of the samples was at or above the MCL for 1,1-DCE (7 ug/L).

In the samples collected in which 1,1,1-TCA was detected, concentrations ranged from not detected to 160 ug/L at MW92-3B during the thirty-eighth quarter. Concentrations detected were below the MCL (200 ug/L) for 1,1,1-TCA during the thirty-eighth and thirty-ninth quarters. 1,1,1-TCA was not detected in groundwater samples collected from the Beller wells.

PCE was detected in wells MW87-3, MW89-12, MW89-15, MW92-3A, MW92-3B, the OI Well, Preister's House well, and P-9 at concentrations ranging from 5 ug/L at MW87-3 to 280 ug/L at MW89-12. Concentrations exceeded the EPA MCL of 5.0 ug/L for PCE in each of the samples where PCE was detected. PCE was not detected in the Beller Domestic , Stock, or Irrigation wells. PCE was consistently detected in May, June, and August 1998 in the Preister House well. Concentrations detected were consistent during each sampling round (13, 16, and 12 ug/L, respectively). PCE was not detected in the Preister Stock or Irrigation wells.

1,1-Dichloroethane was detected from groundwater collected from wells MW89-12 (24 ug/L during the thirty-eighth quarter and 34 ug/L during the thirty-ninth quarter) and MW89-15 (7 ug/L during the thirty-ninth quarter). State and federal MCLs have not been established for 1,1-DCA.

1,2 Dichloroethane (1,2-DCA), 1,2 dichloroethene (1,2-DCE) and TCE were not detected in groundwater samples collected during the thirty-eighth and thirty-ninth quarters.

Organic compounds were not detected in the filtered and unfiltered samples collected from the Beller Domestic well, the Beller Stock well, or the Beller Irrigation well during the monthly and quarterly sampling events from May 1998 through August 1998. Additionally, organic compounds were not detected in the Preister Stock or Irrigation wells. PCE, 1,1,-DCE, and 1,1,1-TCA were consistently detected in samples collected from the Preister House well.

Concentrations of total organics detected during the thirty-eighth and thirty-ninth quarters range from not detected to 513 ug/L at MW89-12 (thirty-eighth quarter). Concentrations of total organics significantly decreased from the thirty-seventh quarter to the thirty-eighth quarter at MW89-12 (2,696 ug/L to 513 ug/L). This well remains the primary interceptor well on-site. Generally, total organics decreased from the thirty-seventh quarter to the thirty-eighth quarter at most wells sampled. Concentrations of total organics generally decreased or were consistent from the thirty-eighth to the thirty-ninth quarter with the exception of groundwater collected from wells MW89-15 and OI Well. Concentrations at MW89-15 increased from 130 ug/L to 293 ug/L. Both wells are upgradient of the MW89-12 interceptor well. Concentrations at the OI Well increased from 6 ug/L to 96 ug/L. Distribution of total residual organic compounds in the aquifer occurs in zones along a northwest to southeast trend with occurrences near wells MW89-15, MW89-12, P-9, MW87-3, MW92-3A, MW92-3B, and Preister's House Well.

5.0 TREATMENT

Center pivot stripping of residual organics occurred during the summer irrigation season in local fields. The intercepted water of well MW89-12 was treated by piping to the sprinkling tower discharging into treatment pond cell #2, in accordance with methods proposed in Lindsay's letter to the EPA and NDEQ dated September 25, 1998. The treated water is discharged in accordance with the NPDES permit.

6.0 CONCLUSIONS

In summary, the following conclusions have been drawn from the information presented in this report and available information from previous groundwater monitoring events.

- Enhanced aquifer remediation has been successful in controlling the residual metals and organics.
- The 1996/1997 approved change in pumping schedule allowing a winter shut down establishes no significant impact to the zones of residuum. The trend in occurrence remained steady. The limited areas of residual exceedences are at the area upgradient of the AOIW (on property) and at monitoring wells MW92-3A and -3B (off property).

- Both areas on and off property are within the capture zones of either interceptor wells or irrigation wells. Based on the results of the May-August treatability study, monitor well MW89-12 has been converted to a top of the aquifer interceptor well capturing localized organic residuum in the upgradient area. This well has been pumped at an average of approximately 60 gallons/minute without reported problems. Lindsay Manufacturing treats the pumped water at treatment pond cell #2 and discharges in accordance with the NPDES permit. The downgradient area is within a triangle of three seasonally operating irrigation wells.

- The water quality in the vicinity of the AOIW, and the wells around MW92-3A and -3B, is suitable for land application as irrigation water and has been applied as such. This is consistent with over 10 years of such application by irrigation well #54278. This application has been investigated in the RI and monitored. The current detection of residuum is far lower in concentration than the initial water pumped by irrigation well #54278 with no deleterious effects. This beneficial use sustains the development of the groundwater resource and is consistent with the 10 years of monitored application by these means on the Beller Farm.

The enhanced remediation is now primarily interception of residual organics. The limiting factor to direct discharge to surface water is the residual zinc which can exceed aquatic life criteria while remaining below drinking water standards. This limit is overcome by stripping off the organics prior to discharge in accordance with the NPDES permit.

7.0 RECOMMENDATIONS

The attenuation of residual metals and organics in the aquifer has occurred through interception. The irrigation wells around MW92-3A and -3B and converted monitoring well upgradient of the AOIW are effectively capturing the residuum. Since application as irrigation water is both beneficial, and an appropriate use of the water resource, we recommend continuation of this remediation program.

We recommend the on-site groundwater remediation to continue through the pumping of MW89-12. Off property groundwater remediation will be completed by the normal seasonal irrigation pumping of the surrounding irrigation wells, with ongoing groundwater monitoring to verify control and success. The OIW will be pumped if required for 30 days prior to the irrigation season if the aquifer water becomes acidic.

In addition, three monitoring wells are no longer utilized for information gathering, and as such, should be abandoned. These wells are the 'Old Well,' P-7, and P-8. These wells should be abandoned according to State of Nebraska/EPA well construction regulations by a licensed well driller in order to prevent potential surface communication with the aquifer.

Table 2
Groundwater Elevations of Sand and Gravel Aquifer
Thirty-Eighth and Thirty-Ninth Quarterly Sampling Rounds
April through September, 1998
Lindsay Manufacturing Company

Station (Well ID)	Reference Elevation	April, 1998		May, 1998		June, 1998		July, 1998		August 17-19, 1998		September, 1998	
		Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation
82-2M	1678.21	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P-1	1677.36	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P-6	1674.96	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
P-9	1674.56	NA	NA	25.25	1649.31	NA	NA	NA	NA	29.45	1645.11	NA	NA
MW87-1	1674.82	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW87-2	1667.91	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW87-3	1697.72	NA	NA	50.35	1647.37	NA	NA	NA	NA	53.60	1644.12	NA	NA
MW87-4	1739.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW87-5	1676.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW87-6	1679.95	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW87-7	1675.35	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW87-8	1676.53	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW89-09A	1727.44	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW89-09B	1727.73	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW89-10A	1717.73	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW89-10B	1718.18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		NA
MW89-11A	1693.32	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW89-11B	1693.57	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW89-12	1675.47	NA	NA	26.94	1648.53	NA	NA	NA	NA	NA	NA	NA	NA
MW89-13	1674.67	NA	NA	24.24	1650.43	NA	NA	NA	NA	26.40	1648.27	NA	NA
MW89-14	1679.66	NA	NA	28.90	1650.76	NA	NA	NA	NA	28.69	1650.97	NA	NA
MW89-15	1678.75	NA	NA	28.90	1649.85	NA	NA	NA	NA	30.20	1648.55	NA	NA
MW92-1	1694.75	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW92-2	1674.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW92-3A	1701.45	NA	NA	56.23	1645.22	NA	NA	NA	NA	62.59	1638.86	NA	NA
MW92-3B	1701.79	NA	NA	56.63	1645.16	NA	NA	NA	NA	62.98	1638.81	NA	NA
OLD CITY WELL	1670.37	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OIW	1675.25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
AOIW	1696.23	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IIW	1758.30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 3
Summary of Wells Sampled and Analytical Plan
Thirty-Eighth and Thirty-Ninth Quarterly Sampling Rounds
April through September, 1998
Lindsay Manufacturing Company

Well	pH (EPA Method 150.1)	Specific Conductivity (EPA Method 120.1)	Volatile Organic Compounds (EPA Method 8260)	Total Zinc (CLP Method)	Sulfate (EPA Method 375.2)	Total Cadmium (CLP Method)	Total Chromium (CLP Method)	Total Iron (CLP Method)	Total Lead (CLP Method)
Samples Collected May 10, 12, and 13, 1998 (Thirty-Eighth Quarter)									
Beller's Domestic (before)	X		X	X	X	X	X	X	X
Beller's Domestic (after)	X		X	X	X	X	X	X	X
Beller's Stock Well	X		X	X	X	X	X	X	X
Beller's Irrigation	X		X	X	X	X	X	X	X
87-3			X						
89-12			X						
89-13			X						
89-14	X		X	X	X		X	X	
89-15	X		X	X	X	X		X	
92-3A			X						
92-3B			X						
AOI Well			X						
OI Well			X						
TI Well			X						
Preister House			X						
P-9 Well			X						
Samples Collected June 23, 1998									
Beller's East Irrigation			X						
Preister's House									
Preister's Stock									
Preister's Irrigation									
Samples Collected August 17 through August 19, 1998 (Thirty-Ninth Quarter)									
Beller's Domestic (before)			X						
Beller's Domestic (after)			X						
Beller's Stock Well			X						
Beller's Irrigation			X						

Table 3
Summary of Wells Sampled and Analytical Plan
Thirty-Eighth and Thirty-Ninth Quarterly Sampling Rounds
April through September, 1998
Lindsay Manufacturing Company

Well	pH (EPA Method 150.1)	Specific Conductivity (EPA Method 120.1)	Volatile Organic Compounds (EPA Method 8260)	Total Zinc (CLP Method)	Sulfate (EPA Method 375.2)	Total Cadmium (CLP Method)	Total Chromium (CLP Method)	Total Iron (CLP Method)	Total Lead (CLP Method)
87-3	X		X	X	X	X	X	X	X
89-12			X						
89-13			X						
89-14	X	X	X		X				
89-15	X	X	X		X				
92-3A			X						
92-3B			X						
AOI Well			X						
OI Well			X						
TI Well			X						
Preister House			X						
Preister's Stock			X						
P-9 Well			X						

Table 4

Summary of Analytical Results for Inorganic Compounds
Thirty-Eighth and Thirty-Ninth Quarterly Sampling Rounds (May, June, and August 1998)
Lindsay Manufacturing Company

Well ID	Lab ID	Field Measurements				Total Metals (mg/L)					
		pH (field)	pH (lab)	Water Temperature (C°) (field)	Specific Conductivity (umhos/cm) (field)	Zinc	Sulfate	Cadmium	Chromium	Iron	Lead
Federal MCL		6.5-8.5*	6.5-8.5*	NS	NS	5.0*	250*	0.005	0.05	0.3*	0.05
Historical Data:											
Old Lindsay Public Supply Well (Sampled January 1977)		NA	7.4	NA	NA	NA	NA	NA	NA	NA	NA
Old Lindsay Public Supply Well (Sampled 01/28/83)		NA	7.2	NA	NA	NA	NA	NA	NA	NA	NA
15261 (Sampled 01/28/83)		NA	7.0	NA	NA	0.31	3.1	U	U	NA	U
15262 (Sampled 01/28/83)		NA	7.1	NA	NA	0.11	14.0	U	U	NA	U
Samples Collected May 10, 12, and 13, 1998											
Beller's Domestic (before)	98-9426-W275A	6.86	7.1 J	11.3	740	**0.787**	31	0.002 U	0.005 U	0.02 U	0.005
Beller's Domestic (after)	98-9427-W275B	6.86	7.1 J	11.7	696	**0.012**	31	0.002 U	0.005 U	0.02 U	0.001 U
Beller's Stock Well	98-9428-W275C	6.87	7.1 J	12.4	720	**0.019**	41	0.002 U	0.005 U	0.02 U	0.001
Beller's Irrigation	98-9646-W3231	7.01	7.3 J	11.3	502	**1.13**	20	0.002 U	0.005 U	0.02 U	0.004
89-14	98-9424-W274D	5.73	5.0 J	12	1026	**23.4 J**	530	NA	0.005 U	3.4	NA
89-15	98-9423-W274C	6.49	6.7 J	11.9	952	**12.3 J**	130	0.002 U	NA	1.67	NA
Samples Collected August 17 through August 19, 1998											
87-3	98-16983-Y286F	6.72	6.7	11.8	790	**0.907**	49	0.002 U	0.009	0.23	0.002
89-14	98-16979-Y286B	5.84	5.7	11.6	1220	NA	430	NA	NA	NA	NA
89-15	98-16978-Y286A	5.54	5.8	11.3	1500	NA	680	NA	NA	NA	NA

Notes:
* EPA secondary MCLs
NA = Not Analyzed or Not Available
NS = No Standard has been established
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected
Bold font indicates result reported as above the detection limit

Table 5
Summary of Analytical Results for Organic Compounds
Thirty-Eighth and Thirty-Ninth Quarterly Sampling Rounds (May, June, and August 1998)
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
State MCL						reserved	NS	NS	reserved	reserved	NS	reserved	
EPA MCL						7	NS	170	5	200	5	5	
Samples Collected May 19, 12 and 13, 1998													
Beller's Domestic (before)	98-9426-W275A	6.86	7.1 J	11.3	740	1 U	1 U	1 U	1 U	1 U	1 U	1 U	ND
Beller's Domestic (after)	98-9427-W275B	6.86	7.1 J	11.7	696	1 U	1 U	1 U	1 U	1 U	1 U	1 U	ND
Beller's Stock Well	98-9428-W275C	6.87	7.1 J	12.4	720	1 U	1 U	1 U	1 U	1 U	1 U	1 U	ND
Beller's Irrigation	98-9646-W123I	7.01	7.3 J	11.3	502	1 U	1 U	1 U	1 U	1 U	1 U	1 U	ND
87-3	98-9638-W311A	6.36		11.9	759	7	5 U	5 U	5 U	9	5 U	9	25
89-12	98-9639-W311B	6.42		12.4	1109	79	24	5 U	5 U	130	5 U	280	513
89-13	98-9422-W274B	6.49		11.5	835	5 U	5 U	5 U	5 U	5 U	5 U	19	19
89-14	98-9424-W274D	5.73	5.0 J	12	1026	41	5 U	5 U	5 U	45	5 U	35	121
89-15	98-9423-W274C	6.49	6.7 J	11.9	952	42	5 U	5 U	5 U	59	5 U	29	130
92-3A	98-9645-W311H	6.98		11.3	549	6	5 U	5 U	5 U	46	5 U	28	80
92-3D	98-9644-W311G	6.61		11.5	1321	48	5 U	5 U	5 U	160	5 U	71	280
AOI Well	98-9641-W311D	6		12.2	588	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	98-9640-W311C	6.45		10.7	733	5 U	5 U	5 U	5 U	5 U	5 U	6	6
TI Well	98-9642-W311E	6.87		10.8	579	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Preister House	98-9643-W311F	7.03		11.1	800	6	5 U	5 U	5 U	13	5 U	13	32
P-9 Well	98-9421-W274A	5.89		12.4	1029	25	5 U	5 U	5 U	29	5 U	97	151
Samples Collected June 23, 1998													
Beller's East Irrigation	98-13110-W787A					5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Preister's House	98-13106-W786A					7	5 U	5 U	5 U	16	5 U	16	39
Preister's Stock	98-13107-W786B					5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Preister's Irrigation	98-13108-W786C					5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND

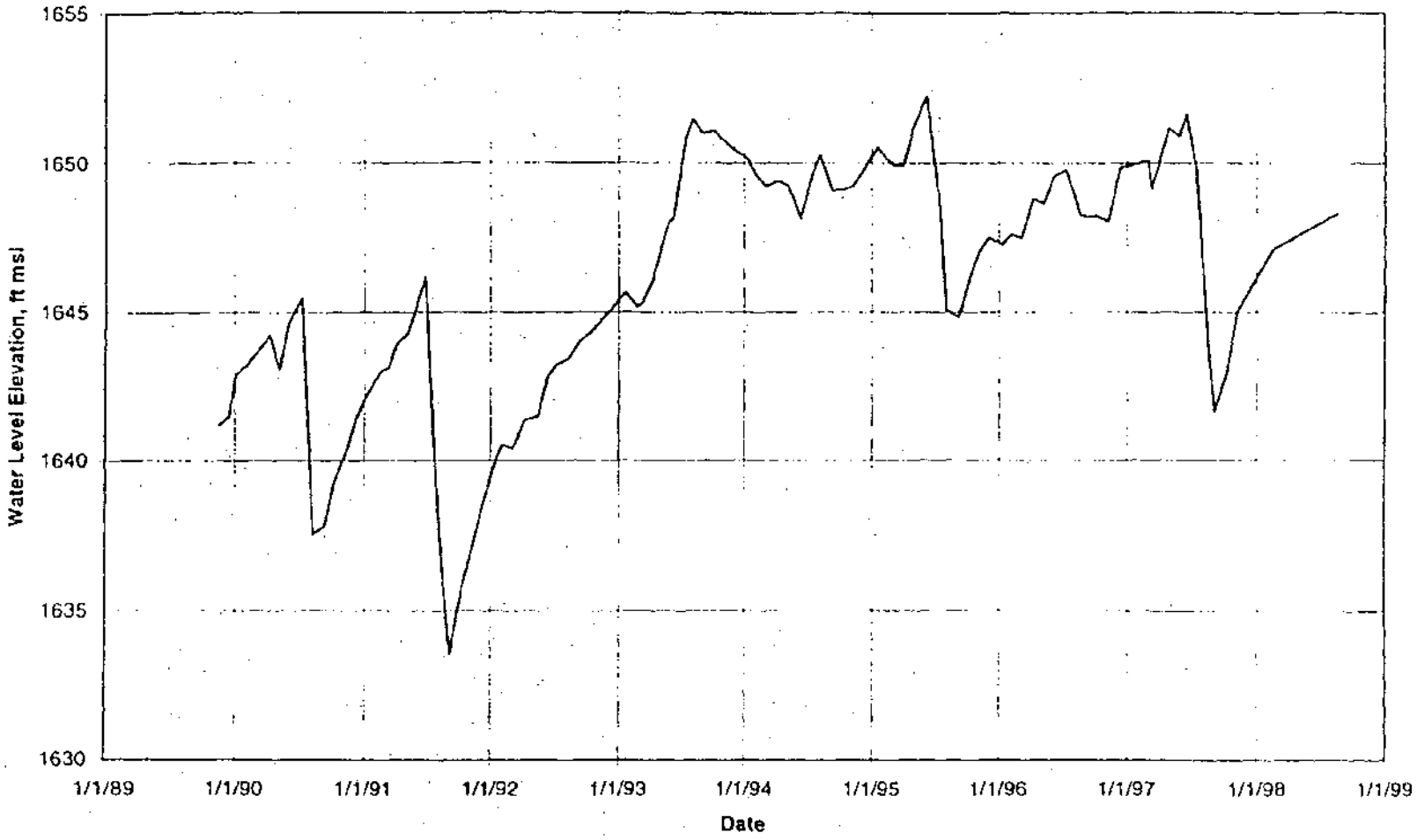
Notes:
ND = Not Detected
NS = No Standard
J = Estimated value
R = Data rejected due to quality assurance parameters
U = Indicates that the compound was analyzed for, but not detected
UJ = Indicates that the compound was analyzed for, but not detected. The associated sample detection limit or quantitation limit is an estimated value
UR = Indicates that the compound was analyzed for, but not detected. The data was also rejected due to quality assurance parameters
Bold font indicates result reported is above the detection limit

Table 5
Summary of Analytical Results for Organic Compounds
Thirty-Eighth and Thirty-Ninth Quarterly Sampling Rounds (May, June, and August 1998)
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (ug/L)	1,1-DCA (ug/L)	1,2-DCE (ug/L)	1,2-DCA (ug/L)	1,1,1-TCA (ug/L)	TCE (ug/L)	PCE (ug/L)	Total Organics (ug/L)
State MCL						reserved	NS	NS	reserved	reserved	NS	reserved	
EPA MCL						7	NS	170	5	200	5	5	
Samples Collected August 17 through August 19, 1998													
Heller's Domestic (before)	98-17570-Y363B	6.93		12.1	680	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Heller's Domestic (after)	98-17569-Y363A	7.04		12.1	680	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Heller's Stock Well	98-17571-Y363C	7.39		14.3	680	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Heller's Irrigation	98-17572-Y363D	6.85		11	550	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
87-3	98-16983-Y286F	6.72	6.7	13.8	790	5 U	5 U	5 U	5 U	7	5 U	5 J	12
89-12	98-16982-Y286E	6.64		13.7	1030	45	34	5 U	5 U	88	5 U	270 J	437
89-13	98-16980-Y286C	7.11		12	840	5 U	5 U	5 U	5 U	5 U	5 U	23 J	23
89-14	98-16979-Y286B	5.84	5.7	11.6	1220	43	5 U	5 U	5 U	56	5 U	27 J	126
89-15	98-16978-Y286A	5.54	5.8	11.5	1300	83	7	5 U	5 U	130	5 U	73 J	293
92-3A	98-17579-Y364F	6.59		11.3	550	5 U	5 U	5 U	5 U	42 J	5 U	14	56
92-3B	98-17580-Y364G	6.35		12	1500	46 J	5 U	5 U	5 U	150 J	5 U	68 J	264
AOI Well	98-16984-Y286G	6.51		11.6	570	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	98-17574-Y364A	6.17		10.6	770	30	5 U	5 U	5 U	46 J	5 U	20	96
TI Well	98-17575-Y364B	6.56		11.3	470	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Preuter House	98-17577-Y364D	6.97		15.9	760	7	5 U	5 U	5 U	19	5 U	12	38
Preuter's Stock	98-17578-Y364E	7.01		13.8	720	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
P-9 Well	98-16981-Y286D	6.62		12	850	5 U	5 U	5 U	5 U	5 U	5 U	16 J	16

Notes:
ND = Not Detected
NS = No Standard
J = Estimated value
R = Data rejected due to quality assurance parameters
U = Indicates that the compound was analyzed for, but not detected
UJ = Indicates that the compound was analyzed for, but not detected. The associated sample detection limit or quantitation limit is an estimated value
UR = Indicates that the compound was analyzed for, but not detected. The data was also rejected due to quality assurance parameters
Bold font indicates result reported is above the detection limit.

MW89-13 Hydrograph (Sand Channel)



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Job No. 16657-002-005

Figure 1
MW89-13 HYDROGRAPH

Lindsay Manufacturing
Lindsay, Nebraska

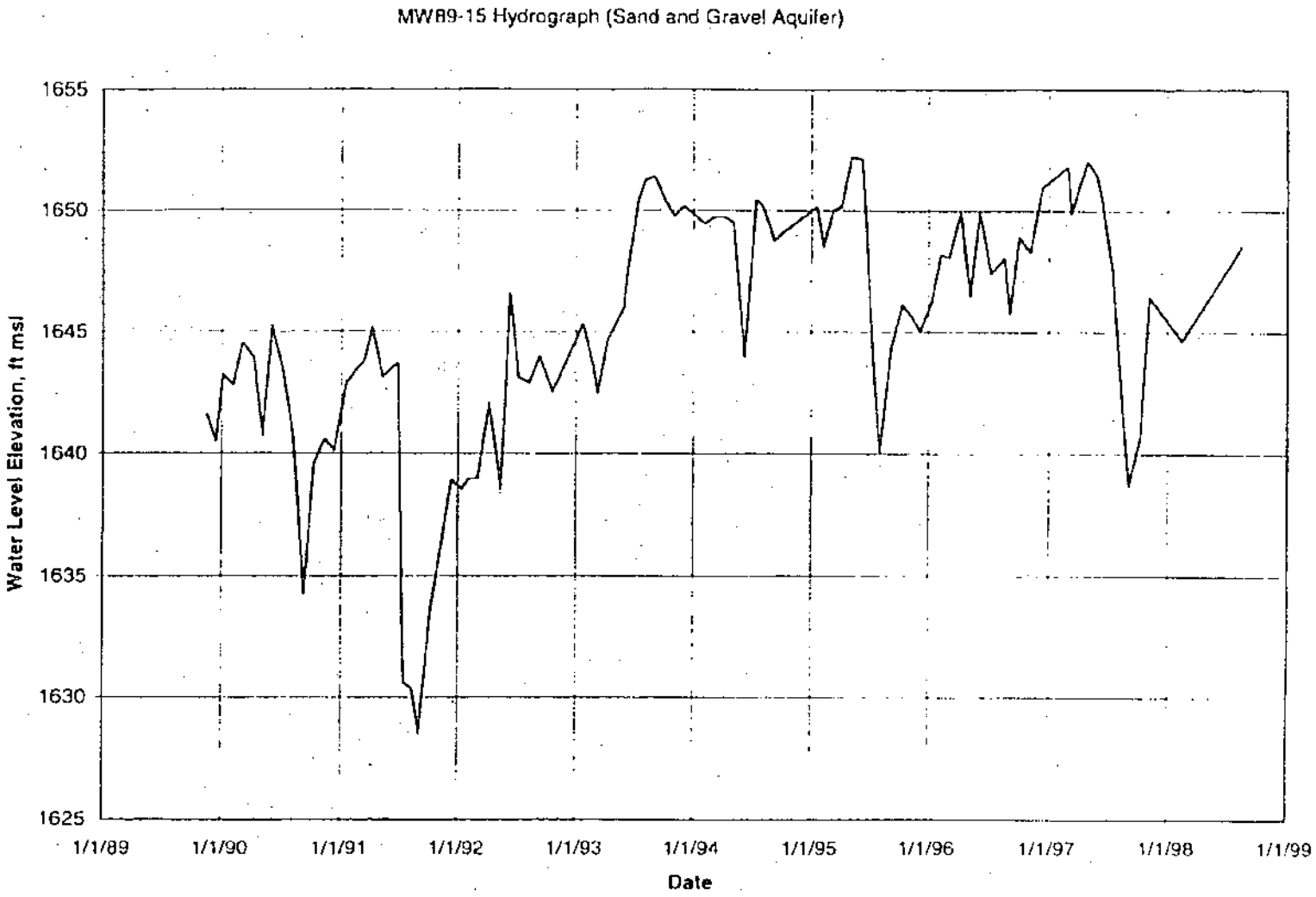

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Figure 2
MW89-15 HYDROGRAPH

Lindsay Manufacturing
Lindsay, Nebraska

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BIANNUAL REPORT ENHANCED GROUNDWATER REMEDIATION PROGRESS LINDSAY MANUFACTURING COMPANY

For

U.S. ENVIRONMENTAL PROTECTION AGENCY
D&M JOB NO.: 16657-002-005
April 8, 1999

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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Seattle, Washington 98121
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April 8, 1999

Ms. Diane Easley
EPA Project Coordinator
United States Environmental Protection Agency
Superfund Division
726 Minnesota Avenue
Kansas City, Kansas 66101

Enhanced Groundwater Remediation
Progress Report
U.S. v. Lindsay Manufacturing Company
C.A. 8:92-00015
D&M Job No.: 16657-002-005

Dear Ms. Easley:

Lindsay Manufacturing Company is pleased to submit this Enhanced Groundwater Remediation Progress Report covering the period from October 1, 1998 to March 31, 1999. This report includes the summaries of Consent Decree items which have been completed or undertaken during the period from October 1, 1998 to March 31, 1999 and the tasks to be completed or undertaken during the next reporting period of April 1, 1999 to September 30, 1999.

Progress in enhanced groundwater remediation has been made and the aquifer restoration is near completion. As such, the final stage of remediation has been changed to a resource sustaining effort. These methods have been tested and found to have merit. These include the application of pumped water to irrigation of crops. This modification to the remediation system was proposed to the EPA and NDEQ by Lindsay in a letter dated September 25 and approved by the EPA and NDEQ in a letter dated November 2, 1998. Based on a May to August, 1998 treatability study, monitoring well MW89-12 was converted to a low-volume extraction well. Continued use of MW89-12, as well as seasonal extraction via regional irrigation wells, will continue in order to capture the residual organics in the aquifer. The OIW will be pumped due to a downward shift in pH during the fall and winter. The OIW will be pumped for 30 days prior to the irrigation season.

Dames & Moore recommends continuing a combination of adjustments in the final stage of aquifer restoration, including: low-volume interception on property through converted monitoring well MW89-12 and monitoring of the ongoing seasonal dispersion of residuum down gradient by the existing irrigation wells. Dames & Moore recommends the continued land application of recovered groundwater during the irrigation season with ongoing monitoring as the final stage of remedial action.

If you have any questions regarding this Enhanced Groundwater Remediation Progress Report, please do not hesitate to call me at your convenience.

Very truly yours,

DAMES & MOORE

Roy W. Elliott
Project Coordinator

TABLE OF CONTENTS

TABLES

FIGURES

ATTACHMENT

1.0 INTRODUCTION

Lindsay Manufacturing Company is pleased to submit this Biannual Report Enhanced Groundwater Remediation Progress covering the period from October 1, 1998 to March 31, 1999. This report covers the fourth quarter of 1998 and the first quarter of 1999 and presents groundwater elevations for the months from October 1998 through March 1999; a summary of groundwater recovery and treatment during the period; and the analytical results from the fortieth and forty-first quarterly rounds of groundwater samples. This report includes the summaries of Consent Decree items which have been completed or undertaken during the period from October 1, 1998 to March 31, 1999 and the tasks to be completed or undertaken during the next reporting period of April 1, 1999 to September 30, 1999. In addition, conclusions and recommendations are offered for the final stage in aquifer remediation.

All items scheduled for completion/submission during this reporting period have been completed on or before the scheduled compliance dates and no unplanned or unresolved delays were encountered.

Items accomplished in this reporting period include the following:

Items	Date Submitted or Performed
Submission of Enhanced Groundwater Remediation Progress Report (XI.27.g)	April 8, 1999
Collection of Fortieth Quarterly Groundwater Samples (XI.21.g)	November 9-11, 1998
Collection of Forty-First Quarterly Groundwater Samples (XI.21.g)	February 1-3, 1999

Items scheduled for completion during the next reporting period include the following:

Items	Scheduled Date
Submission of Enhanced Groundwater Remediation Progress Report (XI.27.g)	April, 1999
Collection of Forty-Second Quarterly Groundwater Samples (XI.21.g)	May, 1999
Collection of Forty-Third Quarterly Groundwater Samples (XI.21.g)	August, 1999

2.0 SUMMARY OF REMEDIAL PUMPING

Monthly summaries of total gallons pumped from each well and the range of pH measured in each well are presented in Table 1. Daily pumping records including the volume, pH and temperature of groundwater pumped are available upon request.

During the fortieth and forty-first quarters, monitor well MW89-12 and the OIW were the only wells operated within the interceptor system. MW89-12 operated between May 29 and December 9, 1998, with only short shutdowns due to mechanical or power problems. The OIW was operated between March 1 and April 2, 1999.

This schedule was operated in order to enhance remediation by intercepting residuum downgradient of the OIW and sand channel while the regional agricultural irrigation wells were idle during the winter to further attenuate downgradient residual contamination as recommended in our April 15, 1997 groundwater remediation report.

The pH in the water of the OIW interceptor well water ranged from 6.29 S.U. to 6.41 S.U. during sampling rounds (Table 1) and 5.7 S.U. to 6.6 S.U. during periodic monitoring. The pH in the water of the AOIW interceptor well water ranged from 6.08 S.U. to 6.12 S.U. during sampling rounds (Table 1). These ranges are similar to previous quarters and exhibit a gradual shift upward toward background.

3.0 GROUNDWATER ELEVATIONS

Groundwater elevations were measured and recorded in 8 select wells and piezometers during the fortieth and forty-first quarterly sampling. Due to the approved decreased water level data collection, sufficient data for creating potentiometric surface maps of the sand and gravel aquifer was not available. The water levels observed in the monitor wells are consistent with previous water levels, accounting for pumping and seasonal fluctuations. Water level data will be updated as further sampling round data is received, but will not be included in this or later reports unless significant departures from historical water levels are noted. Records will be kept and can be supplied upon request if required.

4.0 SUMMARY OF QUARTERLY GROUNDWATER MONITORING

A summary of wells sampled and the analytical program for this period is presented in Table 2. Since the approved limited number of monitoring wells represent principally remediation control monitoring wells, isoconcentration maps could not be prepared. Hence, the analytical data and field measurements of indicator parameters are presented in tabular form and are discussed in the following text. Comparisons to past quarterly sampling results are discussed where useful in understanding the enhanced remediation.

A significant finding is the control of the water quality in the aquifer. The areas of exceedence of cleanup criteria are defined along an axis from source area to the downgradient terminus. No significant deviations occurred in 1998 in this trend, evidence of the control of the ambient flow of groundwater and capture by interceptor and irrigation wells along this axis. This includes data collected after the initiation of interception pumping from MW 89-12, which appears to be containing residuum from the vicinity upgradient of the AOIW.

The Preister house and stock wells have been added to quarterly sampling and analysis (Figure 1). Lindsay Manufacturing has installed treatment on the house well water. Sampling will be pre- and post-treatment and will continue until the Maximum Contaminant Levels have been achieved. The results of the sampling will be reported with the required quarterly reports. There are no records available for the Preister house or stock well, however the irrigation well is 94 feet deep with 40 feet of screen in the sand and gravel aquifer and operates at 1,500 gallons per minute. For more information, refer to Appendix I of the Remedial Investigation.

4.1 FIELD MEASUREMENTS

Field specific conductivity, pH and temperature measurements collected during quarterly sampling events are summarized in Tables 3 and 4.

4.1.1 Perched Sand Channel Results

In the perched sand channel, the pH distribution in groundwater is similar to that observed in the previous quarters, with the lowest pH values occurring toward the northern end of the sand channel. Field specific conductivity values were consistent with previous quarters and seasonal variations.

4.1.2 Sand and Gravel Aquifer Results

Field pH values measured in samples collected from wells screened in the sand and gravel aquifer were similar to previous quarters, with the lowest pH values primarily in the zone adjacent to MW89-15. Field specific conductivity values were consistent with previous quarters and seasonal variations.

4.2 INORGANIC LABORATORY RESULTS

Inorganic analytical laboratory results for the quarterly sampling events are summarized in Table 3. Quality Assurance/Quality Control (QA/QC) review and validation are provided in the attachment to this report and any qualifications are shown by flagged notations in Table 3. In general, inorganic results were found to be acceptable.

4.2.1 Perched Sand Channel Inorganic Results

Zinc and sulfate concentrations detected in the groundwater collected from the perched sand channel (monitoring well MW89-14) during the fortieth and forty-first quarters were consistent with concentrations detected during previous quarters. Concentrations decreased as water levels declined and increased as water levels rose. Zinc and sulfate concentrations detected during the fortieth and forty-first quarters were above the respective MCLs (5.0 mg/L and 250 mg/L).

Iron concentrations detected during the fortieth quarter (5.82 mg/L) increased from the thirty-eighth quarter (3.4 mg/L). The concentration decreased during the forty-first quarter to 3.13 mg/L. Concentrations were above the MCL (0.3 mg/L) during the fortieth and forty-first quarters.

The sample collected from MW89-14 during the fortieth quarter was analyzed for cadmium, chromium, and lead. The concentration of cadmium (0.007 mg/L) was above the MCL (0.005 mg/L). Chromium (0.028 mg/L) and lead (0.002 mg/L) were below the MCLs, 0.05 and 0.05 mg/L, respectively.

Groundwater collected from MW89-13 during the fortieth and forty-first quarters was not analyzed for inorganic compounds in accordance with the alternate year sampling schedule outlined in the May, 1998 modification of the Statement of Work.

4.2.2 Sand and Gravel Aquifer Inorganic Results

During the fortieth quarter, inorganic analyses were performed on samples collected from MW89-15, MW87-3, MW92-3A, MW92-3B, AOI Well, OI Well, TI Well, and Beller's Domestic well. During the forty-first quarter, inorganic analyses were performed only for samples collected from monitoring wells MW89-15 and MW87-3.

For the fortieth and forty-first quarters, zinc concentrations detected were below the secondary MCL (5 mg/L) with the exception of groundwater collected from MW89-15. These concentrations are comparable to the zinc concentrations detected at MW89-15 in November 1997 and February 1998.

Sulfate concentrations detected during the fortieth and forty-first quarters ranged from 21 mg/L at MW92-3A to 460 mg/L at MW92-3B. Sulfate was below the MCL (250 mg/L) in all samples collected with the exception of MW89-15 during the fortieth quarter and forty-first quarter and MW92-3B during the fortieth quarter. Concentrations for these samples were 360 mg/L, 420 mg/L, and 460 mg/L, respectively.

Cadmium was detected in samples collected from wells MW89-15 (0.004 mg/L) during the fortieth quarter and MW87-3 (0.003 mg/L) during the forty-first quarter. Concentrations were below the MCL (0.005 mg/L).

Chromium was detected during the fortieth quarter in samples collected from wells MW87-3 (0.010 mg/L), MW92-3A (0.028 mg/L), MW92-3B (0.040 mg/L), and TI Well (0.006 mg/L). Chromium (0.013 mg/L) was detected in the sample collected from MW87-3 during the forty-first quarter. Concentrations detected were below the MCL (0.05 mg/L).

Iron was detected in all of the wells sampled during the fortieth and forty-first quarters with the exception of the Beller Domestic well. Concentrations ranged from 0.13 mg/L at AOI Well to 3.62 mg/L at MW89-15. Iron concentrations detected at MW87-3 (0.30 and 0.49 mg/L), MW92-3A (0.77 mg/L), MW92-3B (1.01 mg/L), OI Well (1.1 mg/L), and TI Well (0.70 mg/L) were at or above the MCL (0.3 mg/L). The groundwater sample collected from MW89-15 during the fortieth quarter (3.62 mg/L) was above the MCL. The concentration decreased to 0.52 mg/L during the forty-first quarter, just above the MCL.

Lead was not detected in the groundwater samples collected during the fortieth and forty-first quarters with the exception of the TI Well. The detected quantity was 0.001 mg/L, below the MCL (0.05 mg/L).

Inorganic compounds were either not detected at reporting limits or were below MCLs at the Beller's Domestic well. Inorganic analyses were not performed for groundwater collected during the fortieth and forty-first quarters from the Beller Irrigation or Stock wells.

4.3 ORGANIC LABORATORY RESULTS

Organic analytical laboratory results for the quarterly sampling events are summarized in Table 4. Quality Assurance/Quality Control (QA/QC) review and validation are provided in the attachment to this report and any data qualifications are shown by flagged notations in Table 4. In general, organic results were found to be acceptable.

4.3.1 Perched Sand Channel Organic Results

The three predominant organic compounds detected in groundwater samples collected during the fortieth and forty-first sampling rounds from wells screened in the perched sand channel are the same compounds detected in previous quarters: 1,1-dichloroethene (1,1-DCE), 1,1,1-trichloroethane (1,1,1-TCA), and tetrachloroethene (PCE). Concentrations of these compounds detected in sand channel monitoring wells were consistent or decreased from previous sampling rounds.

4.3.2 Sand and Gravel Aquifer Organic Results

Organic compounds were detected in 7 of the 14 wells sampled during the fortieth quarter and in 8 of the 14 wells sampled during the forty-first quarter. Organic compounds were detected in groundwater samples collected from MW87-3, MW89-12, MW89-15, MW92-3A, MW92-3B, the OI Well, Preister's House well (prior to treatment), and Beller's Stock well (Figure 1).

Organic compounds were not detected in the filtered and unfiltered samples collected from the Beller Domestic well, the Beller Stock well, or the Beller Irrigation well during the quarterly sampling events in November 1998 and February 1999 with the exception of 1,1,1-TCA in February 1999. Additionally, organic compounds were not detected in the Preister Stock or Irrigation wells. PCE, 1,1,-DCE, and 1,1,1-TCA were consistently detected in samples collected from the Preister House well.

Concentrations of total organics detected during the fortieth and forty-first quarters range from not detected to 411 ug/L at MW89-15 (forty-first quarter). Concentrations of total organics in the fortieth quarter were similar to concentrations detected during the thirty-ninth quarter; however, decreases were noted at MW89-15 (293 to 168 ug/L), MW92-3B (264 to 197 ug/L), and OI Well (96 to 16 ug/L). An increase was indicated at MW92-3A (56 to 140 ug/L). Concentrations of total organics generally decreased or were consistent from the fortieth to the forty-first quarter with the exception of groundwater collected from wells MW89-15 and OI Well. Concentrations at MW89-15 increased from 168 ug/L to 409 ug/L. Concentrations at the OI Well increased from 16 ug/L to 60 ug/L. Both wells are upgradient of the MW89-12 interceptor well. Distribution of total residual organic compounds in the aquifer occurs in zones along a northwest to southeast trend with occurrences near wells MW89-15, MW89-12, OI Well, MW87-3, MW92-3A, MW92-3B, and Preister's House Well.

5.0 TREATMENT

Center pivot stripping of residual organics will continue during the summer irrigation season in local fields. The intercepted water of well MW89-12 was treated by piping to the sprinkling tower discharging into treatment pond cell #2, in accordance with methods proposed in Lindsay's letter to the EPA and NDEQ dated September 25, 1998. Operation of MW89-12 was halted for winter on December 9, 1998 and will resume on April 19, 1999. OIW water is treated by pumping into the neutralization pond, then discharged into treatment pond cell #2. The treated water is discharged in accordance with the NPDES permit.

6.0 CONCLUSIONS

In summary, the following conclusions have been drawn from the information presented in this report and available information from previous groundwater monitoring events.

- Enhanced aquifer remediation has been successful in controlling the residual metals and organics.

- The 1996/1997 approved change in pumping schedule allowing a winter shut down establishes no significant impact to the zones of residuum. The trend in occurrence remained steady. The limited areas of residual exceedences are at the area upgradient of the AOIW (on property) and at monitoring wells MW92-3A and -3B (off property).

- Both areas on and off property are within the capture zones of either interceptor wells or irrigation wells. Based on the results of the May-August treatability study, monitor well MW89-12 has been converted to a top of the aquifer interceptor well capturing localized organic residuum in the upgradient area. This well has been pumped at an average of approximately 60 gallons/minute without reported problems. Lindsay Manufacturing treats the pumped water at treatment pond cell #2 and discharges in accordance with the NPDES permit. The downgradient area is within a triangle of three seasonally operating irrigation wells.

- The water quality in the vicinity of the AOIW, and the wells around MW92-3A and -3B, is suitable for land application as irrigation water and has been applied as such. This is consistent with over 10 years of such application by irrigation well #54278. This application has been investigated in the RI and monitored. The current detection of residuum is far lower in concentration than the initial water pumped by irrigation well #54278 with no deleterious effects. This beneficial use sustains the development of the groundwater resource and is consistent with the 10 years of monitored application by these means on the Beller Farm.

- A slight depression in pH at and around MW89-15 indicates some winter impact to the sand and gravel aquifer in the vicinity of the OIW.

7.0 RECOMMENDATIONS

The attenuation of residual metals and organics in the aquifer has occurred through interception. The irrigation wells around MW92-3A and -3B and converted monitoring well MW89-12 upgradient of the AOIW are effectively capturing the residuum. Since application as irrigation water is both beneficial, and an appropriate use of the water resource, we recommend continuation of this remediation program.

We recommend the on-site groundwater remediation to continue through the pumping of MW89-12. Pumping at MW89-12 should resume April 19, and the well discharge monitored to determine if compliance with MCLs for organic compounds is achieved. Supplemental pumping of the OIW this spring has been performed prior to the irrigation season to mitigate the slight drop in aquifer water acidity last

winter. Off property groundwater remediation will be completed by the normal seasonal irrigation pumping of the surrounding irrigation wells, with ongoing groundwater monitoring to verify control and success.

ATTACHMENT

QA/QC Memoranda and

Water Quality Results

Table 1
Summary of Pumping Volumes and pH
Fortieth and Forty-First Quarterly Sampling Rounds
October 1998 through March 1999
Lindsay Manufacturing Company

	TIW		AOIW		OIW		MW 89-12		Total
	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Gallons
Monthly Summary									
October, 1998	0	NA	0	NA	0	NA	2,730,801	NA	2,730,801
November, 1998	0	6.82	0	6.12	0	6.41	2,740,169	6.21	2,740,169
December, 1998	0	NA	0	NA	0	NA	701,806	NA	701,806
January, 1999	0	NA	0	NA	0	NA	0	NA	0
February, 1999	0	6.84	0	6.8	0	6.29	0	6.92	0
March, 1999	0	NA	0	NA	30,536,800	NA	0	NA	30,536,800
40th Quarter									
October, November, December, 1998	0	6.82	0	6.12	0	6.41	6,172,776	6.21	6,172,776
41st Quarter									
January, February, March, 1999	0	6.84	0	6.8	30,536,800	6.29	0	6.92	30,536,800
40th and 41st Quarters	0	6.82-9.84	0	6.12-6.8	30,536,800	6.29-6.41	0	6.21-6.92	36,709,576

Table 2
Summary of Wells Sampled and Analytical Plan
Fortieth and Forty-First Quarterly Sampling Rounds (November 1998 and February 1999)
Lindsay Manufacturing Company

Well ID	pH (lab)	Volatile Organic Compounds (EPA Method	Total Zinc (CLP Method)	Sulfate (EPA Method 375.2)	Total Cadmium (CLP Method)	Total Chromium (CLP Method)	Total Iron (CLP Method)	Total Lead (CLP Method)
Samples Collected November, 1998 (Fortieth Quarter)								
Beller's Domestic (before	X	X	X	X	X	X	X	X
Beller's Domestic (after)	X	X	X	X	X	X	X	X
Beller's Stock Well	-	X						
Beller's Irrigation	-	X						
87-3	X	X	X	X	X	X	X	X
89-12	-	X						
89-13	-	X						
89-14	X	X	X	X	X	X	X	X
89-15	X	X	X	X	X	X	X	X
92-3A	X	X	X	X	X	X	X	X
92-3B	X	X	X	X	X	X	X	X
AOI-Well	X	X	X	X	X	X	X	X
OI Well	X	X	X	X	X	X	X	X
TI-Well	X	X	X	X	X	X	X	X
P-9	-	X						
Preister's Domestic (befor	-	X						
Preister's Domestic (after)	-	X						
Preister's Stock	-	X						
Samples Collected February, 1999 (Forty-First Quarter)								
Beller's Domestic (before	-	X						
Beller's Domestic (after)	-	X						
Beller's Stock Well	-	X						
Beller's Irrigation	-	X						
87-3	X	X	X	X	X	X	X	X
89-12	-	X						

Table 2
Summary of Wells Sampled and Analytical Plan
Fortieth and Forty-First Quarterly Sampling Rounds (November 1998 and February 1999)
Lindsay Manufacturing Company

Well ID	pH (lab)	Volatile Organic Compounds (EPA Method	Total Zinc (CLP Method)	Sulfate (EPA Method 375.2)	Total Cadmium (CLP Method)	Total Chromium (CLP Method)	Total Iron (CLP Method)	Total Lead (CLP Method)
Samples Collected February, 1999 (Forty-First Quarter)								
89-13	-	X						
89-14	X	X	X	X		X	X	
89-15	X	X	X	X	X		X	
92-3A	-	X						
92-3B	-	X						
AOI-Well	-	X						
OI Well	-	X						
TI-Well	-	X						
P-9	-	X						
Preister's Domestic (befor	-	X						
Preister's Domestic (after)	-	X						
Preister's Stock	-	X						

Table 3
Summary of Analytical Results for Inorganic Compounds
Fortieth and Forty-First Quarterly Sampling Rounds (November 1998 and February 1999)
Lindsay Manufacturing Company

Well ID	Lab ID	Field Measurements				Total Metals (mg/L)					
		pH (field)	pH (lab)	Water Temperature (C°) (field)	Specific Conductivity (umhos/cm) (field)	Zinc	Sulfate	Cadmium	Chromium	Iron	Lead
Federal MCL		6.5-8.5*	6.5-8.5*	NS	NS	5.0*	250*	0.005	0.05	0.3*	0.05
Historical Data:											
Old Lindsay Public Supply Well (Sampled 01/77)		NA	7.4	NA	NA	NA	NA	NA	NA	NA	NA
Old Lindsay Public Supply Well (Sampled 01/28/83)		NA	7.2	NA	NA	NA	NA	NA	NA	NA	NA
15261 (Sampled 01/28/83)		NA	7.0	NA	NA	0.11	3.1	U	U	NA	U
15262 (Sampled 01/28/83)		NA	7.1	NA	NA	0.11	14.0	U	U	NA	U
Samples Collected November, 1998 (Fortieth Quarter)											
Beller's domestic (before)	**98-23198-Z168A**	**6.99**	**7.1 J**	**18.9**	**650**	**0.050**	**32**	0.002 U	0.005 U	0.020 U	0.001 U
Beller's domestic (after)	**98-23199-Z168B**	**7.03**	**7.2 J**	**19.4**	**610**	**0.047**	**32**	0.002 U	0.005 U	0.020 U	0.001 U
89-14	**98-23190-Z165C**	**5.64**	**5.6 J**	**13.5**	**800**	**18.6**	**420**	**0.007**	**0.028**	**5.82**	**0.002**
89-15	**98-23189-Z165B**	**5.90**	**6.3 J**	**13.3**	**1,170**	**27.9**	**360**	**0.004**	0.005 U	**3.62**	0.001 U
87-3	**98-23191-Z165D**	**6.55**	**6.7 J**	**14.7**	**460**	**0.343**	**38**	0.002 U	**0.019**	**0.30**	0.001 U
92-3A	**98-23409-Z186A**	**7.03**	**6.9 J**	**10.5**	**490**	**0.008**	**21**	0.002 U	**0.028**	**0.77**	0.001 U
92-3B	**98-23410-Z186B**	**6.35**	**6.5 J**	**10.7**	**1,215**	**0.007**	**460**	0.002 U	**0.040**	**1.01**	0.001 U
AOI Well	**98-23411-Z186C**	**6.12**	**6.2 J**	**11.8**	**500**	**3.97**	**66**	0.002 U	0.005 U	**0.13**	0.001 U
OI Well	**98-23188-Z165A**	**6.41**	**6.7 J**	**10.2**	**670**	**3.03**	**51**	0.002 U	0.005 U	**1.1**	0.001 U
TI Well	**98-23412-Z186D**	**6.82**	**6.9 J**	**10.5**	**540**	**1.02**	**30**	0.002 U	**0.006**	**0.70**	**0.001**
Samples Collected February, 1999 (Forty-First Quarter)											
89-14	**99-1186-Z839B**	**5.23**	**5.1 J**	**10.0**	**760**	**21.3**	**470**	NA	**0.005**	**3.13**	NA
89-15	**99-1185-Z839A**	**5.64**	**6.5 J**	**10.1**	**1210**	**22.8**	**420**	0.002 U	NA	**0.52**	NA
87-3	**99-1190-Z839F**	**6.53**	**6.8 J**	**11.0**	**790**	**0.336**	**33**	**0.003**	**0.013**	**0.49**	0.001 U

Notes:
* EPA secondary MCLs
NA = Not Analyzed or Not Available
NS = No Standard has been established
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit
U = Indicates that the compound was analyzed for, but not detected
Bold font indicates result reported is above the detection limit

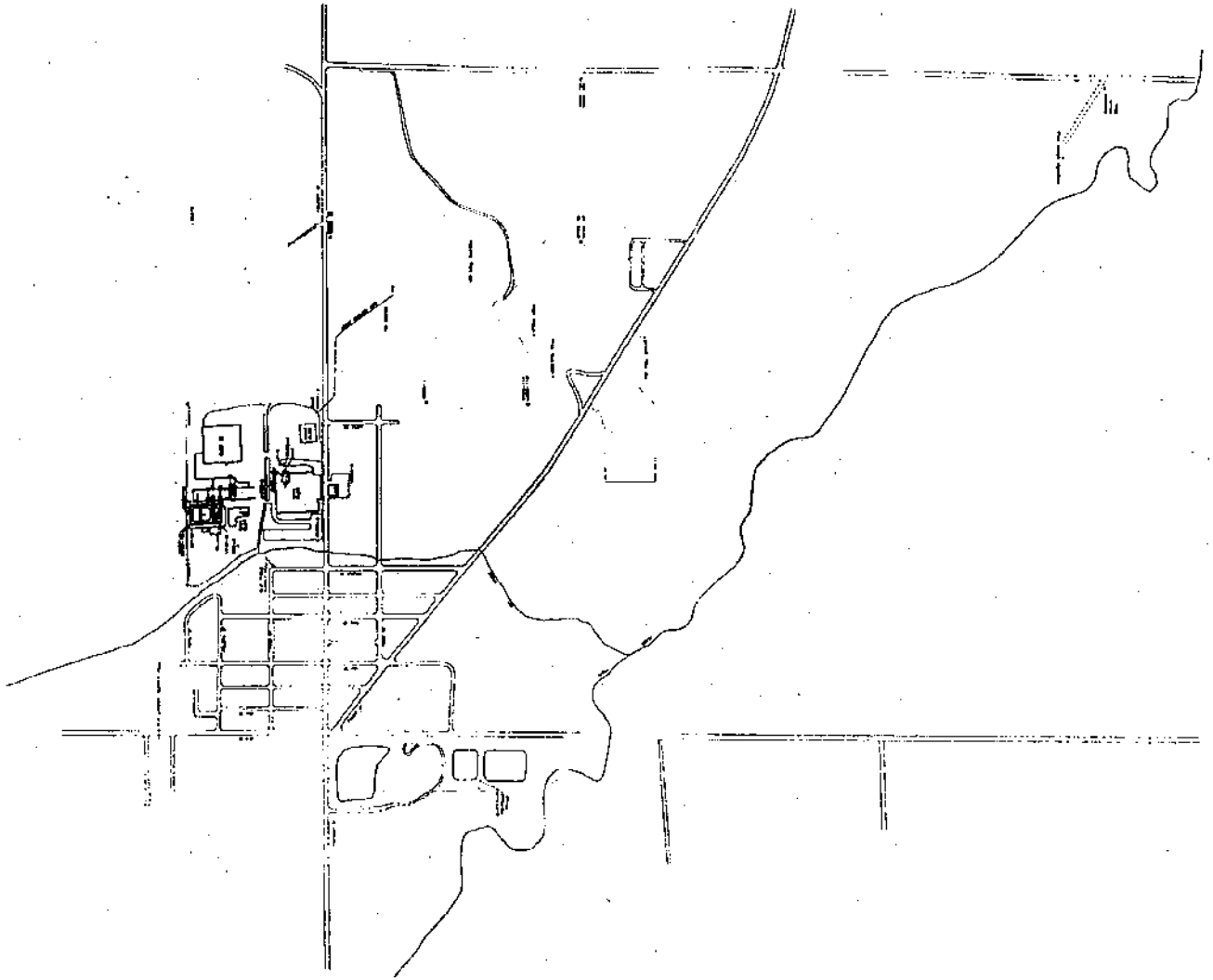
Table 4
Summary of Analytical Results for Organic Compounds
Fortieth and Forty-First Quarterly Sampling Rounds (November 1998 and February 1999)
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
State MCL						reserved	NS	NS	reserved	reserved	NS	reserved	
EPA MCL						7	NS	170	5	200	5	5	
Samples Collected November, 1998 (Fortieth Quarter)													
Beller's Domestic (before	98-23198-Z168A	6.99	7.1 J	18.9	650	1 U	1 U	1 U	1 U	1 U	1 U	1 U	ND
Beller's Domestic (after)	98-23199-Z168B	7.03	7.2 J	19.4	610	1 U	1 U	1 U	1 U	1 U	1 U	1 U	ND
Beller's Stock Well	98-23200-Z168C	7.09	-	10.1	760	1 U	1 U	1 U	1 U	1 U	1 U	1 U	ND
Beller's Irrigation	98-23406-Z184A	7.01	-	11.0	740	1 U	1 U	1 U	1 U	1 U	1 U	1 U	ND
87-3	98-23191-Z165D	6.55	6.7 J	14.7	760	7	5 U	5 U	5 U	12	5 U	6	25
89-12	98-23192-Z165E	6.21	-	14.6	840	44	17	5 U	5 U	130	5 U	220	411
89-13	98-23194-Z165G	7.11	-	14.1	525	5 U	5 U	5 U	5 U	5 U	5 U	20	20
89-14	98-23190-Z165C	5.64	5.6 J	13.5	800	25	5 U	5 U	5 U	24	5 U	22	71
89-15	98-23189-Z165B	5.90	6.3 J	13.3	1,170	57	5 U	5 U	5 U	72	5 U	39	168
92-3A	98-23409-Z186A	7.03	6.9 J	10.5	490	19	5 U	5 U	5 U	83	5 U	38	140
92-3B	98-23410-Z186B	6.35	6.5 J	10.7	1,215	44	5 U	5 U	5 U	110	5 U	43	197
AOI-Well	98-23411-Z186C	6.12	6.2 J	11.8	500	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	98-23188-Z165A	6.41	6.7 J	10.2	670	5	5 U	5 U	5 U	5	5 U	6	16
TI-Well	98-23412-Z186D	6.82	6.9 J	10.5	540	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
P-9	98-23193-Z165F	6.25	-	14.8	510	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Prenster's Domestic (befor	98-23195-Z165H	7.21	-	15.7	710	8	5 U	5 U	5 U	18	5 U	14	40
Prenster's Domestic (after)	98-23196-Z165I	7.07	-	15.2	730	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Prenster's Stock	98-23197-Z165J	7.06	-	11.0	680	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Samples Collected February, 1999 (Forty-First Quarter)													
Beller's Domestic (before	99-1180-Z838A	6.64	-	12.0	740	1 U	1 U	1 U	1 U	1 U	1 U	1 U	ND
Beller's Domestic (after)	99-1181-Z838B	6.79	-	12.0	730	1 U	1 U	1 U	1 U	1 U	1 U	1 U	ND
Beller's Stock Well	99-1182-Z838C	6.84	-	9.0	790	1 U	1 U	1 U	1 U	1	1 U	1 U	1
Beller's Irrigation	99-1183-Z838D	6.95	-	10.2	490	1 U	1 U	1 U	1 U	1 U	1 U	1 U	ND
87-3	99-1190-Z839F	6.53	6.8 J	11.0	790	12	5 U	5 U	5 U	18	5 U	5 U	30
89-12	99-1189-Z839E	6.92	-	11.2	790	15	5 U	5 U	5 U	9	5 U	47	71

Table 4
Summary of Analytical Results for Organic Compounds
Fortieth and Forty-First Quarterly Sampling Rounds (November 1998 and February 1999)
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
State MCL						reserved	NS	NS	reserved	reserved	NS	reserved	
EPA MCL						7	NS	170	5	200	5	5	
Samples Collected February, 1999 (Forty-First Quarter)													
89-13	99-1187-Z839C	6.76	-	10.8	550	5 U	5 U	5 U	5 U	5 U	5 U	26	26
89-14	99-1186-Z839B	5.23	5.1 J	10.0	760	20	5 U	5 U	5 U	21	5 U	19	60
89-15	99-1185-Z839A	5.64	6.5 J	10.1	1210	140	7	5 U	5 U	170	5 U	92	409
92-3A	99-1304-Z853A	6.27	-	10.2	540	6	5 U	5 U	5 U	67	5 U	30	103
92-3B	99-1305-Z853B	6.44	-	10.1	1220	26	5 U	5 U	5 U	87	5 U	35	148
AOI-Well	99-1193-Z839I	6.08	-	11.4	530	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	99-1192-Z839H	6.29	-	10.2	870	22	5 U	5 U	5 U	5	5 U	33	60
TI-Well	99-1194-Z839J	6.84	-	10.1	580	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
P-9	99-1188-Z839D	5.79	-	11.0	610	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Preister's Domestic (befor	99-1306-Z853C	7.11	-	13.5	790	7	5 U	5 U	5 U	14	5 U	14	35
Preister's Domestic (after)	99-1307-Z853D	7.12	-	12.6	810	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Preister's Stock	99-1308-Z853E	7.15	-	9.2	760	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND

Notes:
ND Not Detected
NS No Standard
J Estimated value
U Indicates that the compound was analyzed for, but not detected
UJ Indicates that the compound was analyzed for, but not detected. The associated sample detection limit or quantitation limit is an estimated value
Bold font indicates result reported is above the detection limit



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Job No. 16657-002-005

SITE MAP WITH WELL LOCATIONS

LINDSAY MANUFACTURING
LINDSAY, NEBRASKA

Figure 1

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

October 11, 1999

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Ms. Diane Easley
EPA Project Coordinator
United States Environmental Protection Agency
Superfund Division
726 Minnesota Avenue
Kansas City, Kansas 66101

Enhanced Groundwater Remediation
Progress Report
U.S. v. Lindsay Manufacturing Company
C.A. 8:92-00015
D&M Job No.: 16657-002-005

Dear Ms. Easley:

Lindsay Manufacturing Company is pleased to submit this Enhanced Groundwater Remediation Progress Report covering the period from April 1, 1999 to September 30, 1999. This report includes the summaries of Consent Decree items which have been completed or undertaken during the period from April 1, 1999 to September 30, 1999 and the tasks to be completed or undertaken during the next reporting period of October , 1999 to March 31, 2000.

Enhanced groundwater remediation and the aquifer restoration is near completion. As such, the final stage of remediation was changed to a resource sustaining effort in 1998. The methods were tested and found to have merit. These include the application of pumped water to irrigation of crops. This modification to the remediation system was proposed to the EPA and NDEQ by Lindsay in a letter dated September 25, 1998 and approved by the EPA and NDEQ in a letter dated November 2, 1998. Based on a May to August, 1998 treatability study, monitoring well MW89-12 was converted to a low-volume extraction well. This year's irrigation well operation has augmented the attenuation of residual compounds of concern in the down gradient direction.

Dames & Moore recommends continuing a combination of adjustments in the final stage of aquifer restoration, including: low-volume interception on property through converted monitoring well MW89-12 and monitoring of the ongoing seasonal dispersion of residuum down gradient by the existing irrigation wells. Dames & Moore recommends the continued land application of recovered groundwater during the irrigation season with ongoing monitoring as the final stage of remedial action.

If you have any questions regarding this Enhanced Groundwater Remediation Progress Report, please do not hesitate to call me at your convenience.

Very truly yours,

DAMES & MOORE

Roy W. Elliott

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16657-002-005

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TABLES

FIGURES

ATTACHMENT

1.0 INTRODUCTION

Lindsay Manufacturing Company is pleased to submit this Biannual Enhanced Groundwater Remediation Progress Report covering the period from April 1, 1999 to September 30, 1999. This report covers the second and third quarters of 1999 and presents a summary of groundwater recovery and treatment during the period as well as analytical results from the forty-second and forty-third quarterly rounds of groundwater samples. This report includes the summaries of Consent Decree items which have been completed or undertaken during the period from April 1, 1999, to September 30, 1999, and the tasks to be completed or undertaken during the next reporting period of October 1, 1999, to March 31, 2000. In addition, conclusions and recommendations are offered for the completion of the aquifer remediation.

All items scheduled for completion/submission during this reporting period have been completed on or before the scheduled compliance dates and no unplanned or unresolved delays were encountered.

Items accomplished in this reporting period include the following:

Items	Date Submitted or Performed
Submission of Enhanced Groundwater Remediation Progress Report (XI.27.g)	October 8, 1999
Collection of Forty-Second Quarterly Groundwater Samples (XI.21.g)	May 17 to 20, 1999
Collection of Forty-Third Quarterly Groundwater Samples (XI.21.g)	August 16 to 20, 1999

Items scheduled for completion during the next reporting period include the following:

Items	Scheduled Date
Submission of Enhanced Groundwater Remediation Progress Report (XI.27.g)	April 2000
Collection of Forty-Fourth Quarterly Groundwater Samples (XI.21.g)	November 1999
Collection of Forty-Fifth Quarterly Groundwater Samples (XI.21.g)	February 2000

2.0 SUMMARY OF REMEDIAL PUMPING

Monthly summaries of total gallons pumped from each well and the range of pH measured in each well are presented in Table 1. Daily pumping records including the volume, pH and temperature of groundwater pumped are available upon request.

During the forty-second and forty-third quarters, monitor well MW89-12 was the only well operated within the interceptor system. MW89-12 operated between April 19 and September 30, 1999, with only short shutdowns due to mechanical or power problems.

This schedule was operated in order to enhance remediation by intercepting residuum downgradient of the OIW and sand channel while the regional agricultural irrigation wells further attenuated downgradient residual contamination as recommended in our April 15, 1997, groundwater remediation report.

The pH in the water of the OIW interceptor well water ranged from 6.1 S.U. to 6.68 S.U. during sampling rounds (Table 1). The pH in the water of the AOIW interceptor well water ranged from 5.5 S.U. to 6.2 S.U. during sampling rounds (Table 1). These ranges are similar to previous quarters and exhibit a gradual shift upward toward background.

3.0 GROUNDWATER ELEVATIONS

Groundwater elevations measured during the forty-second and forty-third quarters are consistent with previous water level trends, accounting for pumping and seasonal fluctuations. Due to the approved decreased water level data collection, sufficient data for creating potentiometric surface maps of the sand and gravel aquifer was not available. Water level data will be updated as further sampling round data is received, but will not be included in this or later reports unless significant departures from historical water levels are noted. Records will be kept and can be supplied upon request if required.

4.0 SUMMARY OF QUARTERLY GROUNDWATER MONITORING

A summary of wells sampled and the analytical program for this period is presented in Table 2. Since the approved limited number of monitoring wells represent principally remediation control monitoring wells, isoconcentration maps could not be prepared. Hence, the analytical data and field measurements of indicator parameters are presented in tabular form and are discussed in the following text. Comparisons to past quarterly sampling results are discussed where useful in understanding the enhanced remediation.

A significant finding is the control of the water quality in the aquifer. The areas of exceedence of cleanup criteria are defined along an axis from source area to the downgradient terminus. No significant deviations occurred during the forty-second and forty-third quarters in this trend, evidence of the control of the ambient flow of groundwater and capture by interceptor and irrigation wells along this axis. This includes data collected after the initiation of interception pumping from MW89-12, which appears to be containing residuum from the vicinity upgradient of the AOIW.

The Preister house and stock wells have been added to quarterly sampling and analysis (Figure 1). Lindsay Manufacturing has installed treatment on the house well water. Sampling will be pre- and post-treatment and will continue until the Maximum Contaminant Levels (MCLs) have been achieved. The results of the sampling will be reported with the required semi-annual reports. There are no records available for the Preister house or stock well, however the irrigation well is 94 feet deep with 40 feet of screen in the sand and gravel aquifer and operates at 1,500 gallons per minute. For more information, refer to Appendix I of the Remedial Investigation.

As indicated in Lindsay Manufacturing's letter dated August 23, 1999 to EPA, groundwater samples were collected and analyzed for organic compounds during the forty-third quarter from Ron Pfeifer's and Lester Kopecky's domestic wells. Samples were also collected from Ron Pfeifer's, Anthony Klassen's, and Weylan Neal's irrigation wells. An aerial map showing the locations of these wells was attached to the letter.

4.1 FIELD MEASUREMENTS

Field specific conductivity, pH and temperature measurements collected during quarterly sampling events are summarized in Tables 3 and 4.

4.1.1 Perched Sand Channel Results

In the perched sand channel, the pH distribution in groundwater is similar to that observed in the previous quarters, with the lowest pH values occurring toward the northern end of the sand channel. Field specific conductivity values were consistent with previous quarters and seasonal variations.

4.1.2 Sand and Gravel Aquifer Results

Field pH values measured in samples collected from wells screened in the sand and gravel aquifer were similar to previous quarters. Field specific conductivity values were consistent with previous quarters and seasonal variations.

4.2 INORGANIC LABORATORY RESULTS

Inorganic analytical laboratory results for the quarterly sampling events are summarized in Table 3. Quality Assurance/Quality Control (QA/QC) review and validation are provided in the attachment to this report and any qualifications are shown by flagged notations in Table 3. In general, inorganic results were found to be acceptable.

4.2.1 Perched Sand Channel Inorganic Results

Zinc and sulfate concentrations detected in the groundwater collected from monitoring well MW89-14 during the forty-second and forty-third quarters were consistent with concentrations detected during previous quarters. Zinc and sulfate concentrations detected during the forty-second and forty-third quarters were above the respective MCLs (5.0 mg/L and 250 mg/L). A sample was collected in May 1999 (forty-second quarter) from monitoring well MW89-13. Zinc (0.229 mg/L) and sulfate (49 mg/L) were below MCLs.

Iron concentrations detected during the forty-second quarter (3.04 mg/L) and forty-third quarter (3.20 mg/L) from groundwater collected from monitoring well MW89-14 were consistent with the forty-first quarter (3.13 mg/L). Concentrations were above the secondary MCL (0.3 mg/L). The sample collected from monitoring well MW89-13 contained iron (0.06 mg/L) below the secondary MCL.

Samples collected from MW89-14 and MW89-13 during the forty-second quarter were analyzed for cadmium, chromium, and lead. Concentrations were either not detected or detected at levels below the MCLs. A sample was collected from MW89-14 during the forty-third quarter and analyzed for chromium. Chromium was not detected in this sample.

4.2.2 Sand and Gravel Aquifer Inorganic Results

During the forty-second quarter, inorganic analyses were performed on samples collected from MW87-3, MW89-9A, MW89-9B, MW89-10A, MW89-10B, MW89-12, MW89-15, MW92-1, MW92-3A, MW92-

3B, P-9, Morovec Well, Old City Well, AOI Well (AOIW), OI Well (OIW), TI Well (TIW), and Beller's Domestic, Stock, and Irrigation wells. During the forty-third quarter, inorganic analyses were performed only for samples collected from monitoring wells MW87-3, MW89-15, and Preister's Domestic Well (Before Treatment).

For the forty-second and forty-third quarters, zinc concentrations detected were below the secondary MCL (5 mg/L) with the exception of groundwater collected from MW89-15. Concentrations (12.9 and 27.1 mg/L) were comparable to the zinc concentrations detected at MW89-15 in November 1998 (27.9 mg/L) and February 1999 (22.8 mg/L).

Sulfate concentrations detected during the forty-second and forty-third quarters ranged from 2.8 mg/L at MW89-9A to 490 mg/L at MW92-3B. Sulfate was below the MCL (250 mg/L) in all samples collected with the exception of MW92-3B during the forty-second quarter.

Cadmium was detected in the sample collected from well MW89-15 (0.004 mg/L) during the forty-third quarter. The concentration was below the MCL (0.005 mg/L). Cadmium was not detected in samples collected from other wells.

Chromium was detected during the forty-second quarter in samples collected from wells MW87-3, MW89-9A, MW89-9B, MW89-10A, MW89-10B, MW89-15, MW92-1, MW92-3A, MW92-3B, P-9, OIW, TIW, and the Old City Well. Concentrations ranged from 0.005 to 0.119 mg/L and were below the MCL (0.05 mg/L). Chromium (0.014 mg/L) was detected in the sample collected from MW87-3 during the forty-third quarter. The concentration detected was below the MCL.

Iron was detected in all of the wells sampled during the forty-second and forty-third quarters with the exception of the Beller's Domestic well, MW89-12, Old City Well, and Preister's Domestic well. Concentrations ranged from 0.06 mg/L at Beller's Irrigation well to 5.81 mg/L at MW89-15. Iron concentrations detected during the forty-second quarter at MW89-9B (0.57 mg/L), MW89-10B (0.83 mg/L), MW89-15 (5.81 mg/L), MW92-1 (0.67 mg/L), MW92-3A (0.66 mg/L), MW92-3B (0.68 mg/L), AOIW (0.86 mg/L), OIW (2.77 mg/L), and TIW (0.83 mg/L) were above the secondary MCL (0.3 mg/L). Concentrations detected at MW87-3 (0.65 mg/L) and MW89-15 (5.05 mg/L) during the forty-third quarter were above the secondary MCL.

Lead was detected in the groundwater samples collected during the forty-second and forty-third quarters from MW89-10B, MW89-15, AOIW, TIW, P-9, Morovec Well, Preister's Domestic well, and Beller's Domestic, Stock, and Irrigation wells. Concentrations ranged from 0.001 to 0.045 mg/L, below the MCL (0.05 mg/L).

Inorganic compounds were either not detected or were below MCLs in samples collected at Beller's Domestic, Stock, and Irrigation wells and Preister's Domestic well.

4.3 ORGANIC LABORATORY RESULTS

Organic analytical laboratory results for the quarterly sampling events are summarized in Table 4. Quality Assurance/Quality Control (QA/QC) review and validation are provided in the attachment to this report and

any data qualifications are shown by flagged notations in Table 4. In general, organic results were found to be acceptable.

4.3.1 Perched Sand Channel Organic Results

The three predominant organic compounds detected in groundwater samples collected during the forty-second and forty-third sampling rounds from wells screened in the perched sand channel are the same compounds detected in previous quarters: 1,1-dichloroethene (1,1-DCE), 1,1,1-trichloroethane (1,1,1-TCA), and tetrachloroethene (PCE). Concentrations of these compounds detected in sand channel monitoring wells were consistent or decreased from previous sampling rounds.

4.3.2 Sand and Gravel Aquifer Organic Results

Organic compounds were detected in 9 of the 25 wells sampled during the forty-second quarter and in 11 of the 24 wells sampled during the forty-third quarter. Organic compounds were detected in groundwater samples collected from MW87-3, MW89-12, MW89-15, MW92-3A, MW92-3B, the OIW, Preister's Domestic well (prior to treatment), Beller's Stock well (Figure 1), and Weylon Neal's Irrigation well (not depicted).

Organic compounds were not detected in the filtered and unfiltered samples collected from the Beller Domestic well or the Beller Irrigation well during the forty-second and forty-third quarterly sampling events. 1,1,1-TCA and PCE were detected in the Beller Stock well during both quarters. Concentrations were below MCLs. Additionally, organic compounds were not detected in the Preister Stock well. PCE, 1,1,-DCE, 1,1-dichloroethane (1,1-DCA), and 1,1,1-TCA were consistently detected in samples collected from the Preister House well prior to filtration. Organic compounds were not detected in the samples collected after filtration.

Organic compounds were not detected in samples collected from Ron Pfeifer's or Lester Kopecky's domestic wells. Organic compounds were also not detected in samples collected from irrigation wells for Ron Pfeifer and Anthony Klassen. The sample collected from Weylan Neal's irrigation well contained 1,1,1-TCA (10 ug/L), well below the MCL (200 ug/L).

Concentrations of total organics detected during the forty-second and forty-third quarters range from not detected to 708 ug/L at MW89-12 (forty-second quarter). Concentrations of total organics generally decreased or were consistent from the forty-first to the forty-third quarter. The concentration of organic compounds at MW89-12 fluctuated with an increase from 71 to 708 ug/L from the forty-first to the forty-second quarter. The concentration decreased to 242 ug/L during the forty-third quarter. The fluctuation is likely due to the use of MW89-12 as an interceptor well.

Total organic concentrations at MW92-3A and MW92-3B during the forty-second quarter were 199 ug/L and 311 ug/L, respectively. The concentrations at both of these wells decreased during the forty-third quarter to 20 ug/L and 149 ug/L, respectively.

Distribution of total residual organic compounds in the aquifer occurs in zones along a northwest to southeast trend with occurrences near wells MW89-15, MW89-12, OIW, MW87-3, MW92-3A, MW92-3B, and Preister's House Well.

5.0 TREATMENT

Center pivot stripping of residual organics continued during the summer irrigation season in local fields. The intercepted water of well MW89-12 was treated by piping to the sprinkling tower discharging into treatment pond cell #2, in accordance with methods proposed in Lindsay's letter to the EPA and NDEQ dated September 25, 1998. The treated water is discharged in accordance with the NPDES permit.

6.0 CONCLUSIONS

In summary, the following conclusions have been drawn from the information presented in this report and available information from previous groundwater monitoring events.

- Enhanced aquifer remediation has been successful in controlling the residual metals and organics.
- The 1996/1997 approved change in pumping schedule allowing a winter shut down establishes no significant impact to the zones of residuum. The trend in occurrence remained steady. The limited areas of residual exceedances are at the area upgradient of the AOIW (on property) and at monitoring wells MW92-3A and -3B (off property).
- Both areas on and off property are within the capture zones of either interceptor wells or irrigation wells. Based on the results of the May-August 1998 treatability study, monitor well MW89-12 has been converted to a top of the aquifer interceptor well capturing localized organic residuum in the upgradient area. This well has been pumped at an average of approximately 54 gallons/minute without reported problems. Lindsay Manufacturing treats the pumped water at treatment pond cell #2 and discharges in accordance with the NPDES permit. The downgradient area is within a triangle of three seasonally operating irrigation wells.
- Low precipitation during the summer of 1999 led to pumping of the local irrigation wells, and the resulting dispersion of residuum is seen in decreased organics concentrations in wells MW92-3A and MW92-3B during the forty-third quarter sampling round.
- The water quality in the vicinity of the AOIW, and the wells around MW92-3A and -3B, is suitable for land application as irrigation water and has been applied as such. This is consistent with over 10 years of such application by irrigation well #54278. This application has been investigated in the RI and monitored. The current detection of residuum is far lower in concentration than the initial water pumped by irrigation well #54278 with no deleterious effects. This beneficial use sustains the development of the groundwater resource and is consistent with the 10 years of monitored application by these means on the Beller Farm.
- A slight depression in pH at and around MW89-15 indicates some summer impact to the sand and gravel aquifer in the vicinity of the OIW.

The enhanced remediation is now primarily interception of residual organics. This limit is overcome by stripping off the organics prior to discharge in accordance with the NPDES permit.

7.0 RECOMMENDATIONS

The attenuation of residual metals and organics in the aquifer has occurred through interception. The irrigation wells around MW92-3A and -3B and converted monitoring well MW89-12 upgradient of the AOIW are effectively capturing the residuum. Since application as irrigation water is both beneficial, and an appropriate use of the water resource, we recommend continuation of this remediation program.

We recommend the on-site groundwater remediation to continue through the seasonal pumping of MW89-12. Pumping at MW89-12 should continue, and the well discharge monitored to determine if compliance with MCLs for organic compounds is achieved. Off property groundwater remediation by attenuation through the normal seasonal irrigation pumping of the surrounding irrigation wells is an appropriate final remedy. This remedy should include ongoing groundwater monitoring to verify control and success.

Table 1
Summary of Pumping Volumes and pH
Forty-Second and Forty-Third Quarters
April 1999 through September 1999
Lindsay Manufacturing Company

	TIW		AOIW		OIW		MW 89-12		Total
	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Gallons
Monthly Summary									
April, 1999	0	NA	0	NA	0	NA	932,126	NA	932,126
May, 1999	0	6.8	0	6.2	0	6.68	2,173,088	6.4	2,173,088
June, 1999	0	NA	0	NA	0	NA	2,641,624	NA	2,641,624
July, 1999	0	NA	0	NA	0	NA	2,071,307	NA	2,071,307
August, 1999	0	6.08	0	5.5	0	6.1	2,715,664	6.85	2,715,664
September, 1999	0	NA	0	NA	0	NA	2,301,416	NA	2,301,416
42nd Quarter									
April, May, June, 1999	0	6.8	0	6.2	0	6.68	5,746,838	6.4	5,746,838
43rd Quarter									
July, August, September, 1999	0	6.08	0	5.5	0	6.1	7,088,387	6.85	7,088,387
42nd and 43rd Quarters	0	6.08-6.8	0	5.5-6.2	0	6.1-6.68	12,835,225	6.4-6.85	12,835,225

Table 2
Summary of Wells Sampled and Analytical Plan
Forty-Second and Forty-Third Quarterly Sampling Rounds
April 1999 through September 1999
Lindsay Manufacturing Company

Well ID	pH (lab) (EPA Method 150.1)	Volatile Organic Compounds (EPA Method 8260)	Total Zinc (CLP Method)	Sulfate (EPA Method 375.2)	Total Cadmium (CLP Method)	Total Chromium (CLP Method)	Total Iron (CLP Method)	Total Lead (CLP Method)
Samples Collected May 1999 (Forty-Second Quarter)								
Beller's Domestic (before)	X	X	X	X	X	X	X	X
Beller's Domestic (after)	X	X	X	X	X	X	X	X
Beller's Stock Well	X	X	X	X	X	X	X	X
Beller's Irrigation	X	X	X	X	X	X	X	X
87-3	X	X	X	X	X	X	X	X
89-9A	X	X	X	X	X	X	X	X
89-9B	X	X	X	X	X	X	X	X
89-10A	X	X	X	X	X	X	X	X
89-10B	X	X	X	X	X	X	X	X
89-12	X	X	X	X	X	X	X	X
89-13	X	X	X	X	X	X	X	X
89-14	X	X	X	X	X	X	X	X
89-15	X	X	X	X	X	X	X	X
92-1	X	X	X	X	X	X	X	X
92-3A	X	X	X	X	X	X	X	X
92-3B	X	X	X	X	X	X	X	X
AOI Well	X	X	X	X	X	X	X	X
OI Well	X	X	X	X	X	X	X	X
TI Well	X	X	X	X	X	X	X	X
P-9 Well	X	X	X	X	X	X	X	X
Preister's Domestic (Before)		X						
Preister's Domestic (After)		X						
Preister's Stock		X						
Morovec Well	X	X	X	X	X	X	X	X
Old City Well	X	X	X	X	X	X	X	X

Table 2
Summary of Wells Sampled and Analytical Plan
Forty-Second and Forty-Third Quarterly Sampling Rounds
April 1999 through September 1999
Lindsay Manufacturing Company

Well ID	pH (lab) (EPA Method 150.1)	Volatile Organic Compounds (EPA Method 8260)	Total Zinc (CLP Method)	Sulfate (EPA Method 375.2)	Total Cadmium (CLP Method)	Total Chromium (CLP Method)	Total Iron (CLP Method)	Total Lead (CLP Method)
<u>Samples Collected August 1999 (Forty Third Quarter)</u>								
Bellers Domestic (Before)	X	X						
Bellers Domestic (After)	X	X						
Bellers Stock	X	X						
Bellers Irrigation	X	X						
87-3	X	X	X	X	X	X	X	X
89-12 Well	X	X						
89-13 Well	X	X						
89-14 Well	X	X	X	X		X	X	
89-15 Well	X	X	X	X	X		X	
92-3A Well	X	X						
92-3B Well	X	X						
AOI Well	X	X						
OI Well	X	X						
TI Well	X	X						
P-9 Well	X	X						
Preister's Domestic (Before)	X	X	X		X	X	X	X
Preister's Domestic (After)	X	X						
Preister's Stock	X	X						
Ron Pfeifer's Irrigation	X	X						
Ron Pfeifer's House Well	X	X						
Lester Kopecky House Well	X	X						
Wendell Neal Irrigation	X	X						
Klassen Irrigation Well	X	X						
Klassen Irrigation Well	X	X						

Table 3
Summary of Analytical Results for Inorganic Compounds
Forty-Second and Forty-Third Quarterly Sampling Rounds (April 1999 through September 1999)
Lindsay Manufacturing Company

Well ID	Lab ID	Field Measurements				Total Metals (mg/L)					
		pH (field)	pH (lab)	Water Temperature (C^{O}) (field)	Specific Conductivity (umhos/cm) (field)	Zinc	Sulfate	Cadmium	Chromium	Iron	Lead
Federal MCL		6.5-8.5*	6.5-8.5*	NS	NS	5.0*	250*	0.005	0.05	0.3*	0.05
Historical Data:											
Old Lindsay Public Supply Well (Sampled January 1977)		NA	7.4	NA	NA	NA	NA	NA	NA	NA	NA
Old Lindsay Public Supply Well (Sampled 01/28/83)		NA	7.2	NA	NA	NA	NA	NA	NA	NA	NA
15261 (Sampled 01/28/83)		NA	7.0	NA	NA	0.11	3.1	U	U	NA	U
15262 (Sampled 01/28/83)		NA	7.1	NA	NA	0.11	14.0	U	U	NA	U
Samples Collected May 1999 (Forty-Second Quarter)											
Beller's Domestic (before)	99-6803-AH25A	6.91	7.0 J	15.1	650	0.103	33	0.002 U	0.005 U	0.02 U	0.003
Beller's Domestic (after)	99-6804-AH25B	6.85	7.0 J	15.9	660	0.022	34	0.002 U	0.005 U	0.02 U	0.001
Beller's Stock Well	99-6805-AH25C	7.29	6.9 J	12.4	670	0.080	69	0.002 U	0.005 U	0.1	0.004
Beller's Irrigation	99-6865-AH36A	7.49	6.9 J	14.0	500	0.614	16	0.002 U	0.005 U	0.06	0.008
87-3	99-6756-AH18L	6.47	6.7 J	15	680	0.199	28	0.002 U	0.01	0.2	0.001 U
89-9A	99-6868-AH37B	7.20	7.1 J	14.2	540	0.008	2.8	0.002 U	0.005	0.06	0.001 U
89-9B	99-6869-AH37C	7.28	7.0 J	15	540	0.006	8.4	0.002 U	0.045	0.57	0.001 U
89-10A	99-6871-AH37E	7.36	7.0 J	15.1	540	0.009	16	0.002 U	0.015	0.16	0.001 U
89-10B	99-6872-AH37F	7.50	7.0 J	15	550	0.005	41	0.002 U	0.119	0.83	0.001
89-12	99-6755-AH18K	6.40	6.6 J	10.1	660	0.794	75	0.002 U	0.005 U	0.02 U	0.001 U
89-13	99-6750-AH18F	7.01	7.2 J	14	540	0.229	49	0.002 U	0.005 U	0.06	0.001 U
89-14	99-6752-AH18H	5.48	5.1 J	15	620	13.7	290	0.004	0.005 U	3.04	0.001 U
89-15	99-6751-AH18G	6.52	6.5 J	14	810	12.9	98	0.002 U	0.007	5.81	0.002
92-1	99-6870-AH37D	7.27	6.8 J	14.9	770	0.194	91	0.002 U	0.022	0.67	0.001 U
92-3A	99-6749-AH18E	6.98	7.0 J	14.4	490	0.011	19	0.002 U	0.057	0.66	0.001 U
92-3B	99-6748-AH18D	6.45	6.4 J	14.5	1150	0.008	490	0.002 U	0.049	0.68	0.001 U
AOI Well	99-6746-AH18B	6.20	6.3 J	14.8	440	3.28	53	0.002 U	0.005 U	0.86	0.004
OI Well	99-6745-AH18A	6.68	6.6 J	12.0	600	3.35	49	0.002 U	0.005	2.77	0.001 U
TI Well	99-6747-AH18C	6.80	6.9 J	14.2	540	0.887	20	0.002 U	0.005	0.83	0.045
P-9 Well	99-6867-AH37A	6.41	6.6 J	15.3	560	0.471	27	0.002 U	0.011	0.07	0.001
Morovec Well	99-6807-AH18M	7.20	7.1 J	16.1	880	0.29	50	0.002 U	0.005 U	0.14	0.004
Old City Well	99-6987-AH62A	6.24	6.7 J	15.9	1090	0.01	44	0.002 U	0.006	0.02 U	0.001 U

Table 3
Summary of Analytical Results for Inorganic Compounds
Forty-Second and Forty-Third Quarterly Sampling Rounds (April 1999 through September 1999)
Lindsay Manufacturing Company

Well ID	Lab ID	Field Measurements				Total Metals (mg/L)					
		pH (field)	pH (lab)	Water Temperature (C^{O}) (field)	Specific Conductivity (umhos/cm) (field)	Zinc	Sulfate	Cadmium	Chromium	Iron	Lead
Federal MCL		6.5-8.5*	6.5-8.5*	NS	NS	5.0*	250*	0.005	0.05	0.3*	0.05
Historical Data:											
Old Lindsay Public Supply Well (Sampled January 1977)		NA	7.4	NA	NA	NA	NA	NA	NA	NA	NA
Old Lindsay Public Supply Well (Sampled 01/28/83)		NA	7.2	NA	NA	NA	NA	NA	NA	NA	NA
15261 (Sampled 01/28/83)		NA	7.0	NA	NA	0.11	3.1	U	U	NA	U
15262 (Sampled 01/28/83)		NA	7.1	NA	NA	0.11	14.0	U	U	NA	U
Samples Collected August 1999, (Forty-Third Quarter)											
87-3 Well	99-12126-AQ38H	6.59	6.8 J	12.7	760	**0.413**	**31**	0.002 U	**0.014**	**0.65**	0.001 U
89-14 Well	99-12123-AQ38E	4.86	4.9 J	12.2	1110	**18.9**	350	NA	0.005 U	**3.20**	NA
89-15 Well	99-12122-AQ38D	6.20	6.4 J	12	1080	**27.1**	200	0.004	NA	**5.05**	NA
Preister's Domestic (Before)	99-12129-AQ38K	6.43	NA	18.7	920	**0.052**	NA	0.002 U	0.005 U	0.02 U	0.003

Notes:
* EPA secondary MCLs
NA = Not Analyzed or Not Available
NS = No Standard has been established.
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
Bold font indicates result reported is above the detection limit.

Table 4
Summary of Analytical Results for Organic Compounds
Forty-Second and Forty-Third Quarterly Sampling Rounds (April 1999 through September 1999)
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
State MCL						reserved	NS	NS	reserved	reserved	NS	reserved	-
EPA MCL						7	NS	170	5	200	5	5	-
Samples Collected May 1999, (Forty-Second Quarter)													
Beller's Domestic (before)	99-6803-AH25A	6.91	7.0 J	15.1	650	1 U	1 U	1 U	1 U	1 U	1 U	1 U	ND
Beller's Domestic (after)	99-6804-AH25B	6.85	7.0 J	15.9	660	1 U	1 U	1 U	1 U	1 U	1 U	1 U	ND
Beller's Stock Well	99-6805-AH25C	7.29	6.9 J	12.4	670	1 U	1 U	1 U	1 U	2	1 U	1	3
Beller's Irrigation	99-6865-AH36A	7.49	6.9 J	14.0	500	1 U	1 U	1 U	1 U	1 U	1 U	1 U	ND
87-3	99-6756-AH18L	6.47	6.7 J	15	680	10	5 U	5 U	5 U	16	5 U	5 U	26
89-9A	99-6868-AH37B	7.20	7.1 J	14.2	540	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
89-9B	99-6869-AH37C	7.28	7.0 J	15	540	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
89-10A	99-6871-AH37E	7.36	7.0 J	15.1	540	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
89-10B	99-6872-AH37F	7.50	7.0 J	15	550	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
89-12	99-6755-AH18K	6.40	6.6 J	10.1	660	63	15	5 U	5 U	270	5 U	360	708
89-13	99-6750-AH18F	7.01	7.2 J	14	540	5 U	5 U	5 U	5 U	5 U	5 U	29	29
89-14	99-6752-AH18H	5.48	5.1 J	15	620	32	5 U	5 U	5 U	30	5 U	24	86
89-15	99-6751-AH18G	6.52	6.5 J	14	810	6	5 U	5 U	5 U	25	5 U	15	46
92-1	99-6870-AH37D	7.27	6.8 J	14.9	770	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
92-3A	99-6749-AH18E	6.98	7.0 J	14.4	490	25	5 U	5 U	5 U	120	5 U	54	199
92-3B	99-6748-AH18D	6.45	6.4 J	14.5	1150	58	5 U	5 U	5 U	180	5 U	73	311
AOI Well	99-6746-AH18B	6.20	6.3 J	14.8	440	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	99-6745-AH18A	6.68	6.6 J	12.0	600	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
TI Well	99-6747-AH18C	6.80	6.9 J	14.2	540	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
P-9 Well	99-6867-AH37A	6.41	6.6 J	15.3	560	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Preister's Domestic (Before)	99-6753-AH18I	7.03	NA	15.3	780	14	5	5 U	5 U	32	5 U	31	82
Preister's Domestic (After)	99-6754-AH18J	7.08	NA	15.2	770	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Preister's Stock	99-6808-AH18N	7.12	NA	15.1	670	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Morovec Well	99-6807-AH18M	7.20	7.1 J	16.1	880	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Old City Well	99-6987-AH62A	6.24	6.7 J	15.9	1090	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND

Table 4
Summary of Analytical Results for Organic Compounds
Forty-Second and Forty-Third Quarterly Sampling Rounds (April 1999 through September 1999)
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
State MCL						reserved	NS	NS	reserved	reserved	NS	reserved	-
EPA MCL						7	NS	170	5	200	5	5	-
Samples Collected August 1999, (Forty-Third Quarter)													
Bellers Domestic (Before)	99-12145-AQ39A	6.74	NA	11.6	720	1 U	1 U	1 U	1 U	1 U	1 U	1 U	ND
Bellers Domestic (After)	99-12146-AQ39B	6.77	NA	NA	710	1 U	1 U	1 U	1 U	1 U	1 U	1 U	ND
Bellers Stock	99-12147-AQ39C	7.35	NA	12.1	830	1 U	1 U	1 U	1 U	2	1 U	2	4
Bellers Irrigation	99-12148-AQ39D	5.71	NA	12	510	1 U	1 U	1 U	1 U	1 U	1 U	1 U	ND
87-3	99-12126-AQ38H	6.59	6.8 J	12.7	760	7	5 U	5 U	5 U	18	5 U	5 U	25
89-12 Well	99-12124-AQ38F	6.85	NA	11.8	813	28	12	5 U	5 U	72	5 U	130	242
89-13 Well	99-12125-AQ38G	6.90	NA	11.4	540	5 U	5 U	5 U	5 U	5 U	5 U	39	39
89-14 Well	99-12123-AQ38E	4.86	4.9 J	12.2	1110	36	5 U	5 U	5 U	36	5 U	21	93
89-15 Well	99-12122-AQ38D	6.20	6.4 J	12	1080	43	5 U	5 U	5 U	55	5 U	30	128
92-3A Well	99-12244-AQ61A	6.62	NA	11.7	610	5 U	5 U	5 U	5 U	14	5 U	6	20
92-3B Well	99-12245-AQ61B	6.30	NA	11.9	1240	18	5 U	5 U	5 U	92	5 U	39	149
AOI Well	99-12120-AQ38B	5.50	NA	12	460	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
DI Well	99-12121-AQ38C	6.10	NA	10.9	700	5 U	5 U	5 U	5 U	5 U	5 U	10	10
TI Well	99-12119-AQ38A	6.08	NA	12	570	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
P-9 Well	99-12128-AQ38J	6.37	NA	12.7	460	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Preister's Domestic (Before)	99-12129-AQ38K	6.43	NA	18.7	920	20	6	5 U	5 U	40	5 U	31	97
Preister's Domestic (After)	99-12130-AQ38L	6.83	NA	19.4	940	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Preister's Stock	99-12131-AQ38M	7.07	NA	15.2	800	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Ron Pfeifer's Irrigation	99-12246-AQ61C	7.26	NA	11.5	620	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Ron Pfeifer's House Well	99-12247-AQ61D	7.13	NA	13.0	640	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Lester Kopecky House Well	99-12248-AQ61E	6.94	NA	11.4	630	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Weylan Neal Irrigation	99-12249-AQ61F	7.17	NA	10.6	1110	5 U	5 U	5 U	5 U	10	5 U	5 U	10
Klassen Irrigation Well	99-12250-AQ61G	7.63	NA	11.8	560	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Klassen Irrigation Well	99-12473-AR01A	6.79	NA	11.2	650	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND

Notes:
ND = Not Detected NS = No Standard
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit
U = Indicates that the compound was analyzed for, but not detected.
Bold font indicates result reported is above the detection limit.

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

BIANNUAL REPORT ENHANCED GROUNDWATER REMEDIATION PROGRESS PERIOD COVERING OCTOBER 1, 1999 TO MARCH 31, 2000 LINDSAY MANUFACTURING COMPANY

For

U.S. ENVIRONMENTAL PROTECTION AGENCY

D&M JOB NO.: 16657-002-005

May 24, 2000

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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May 24, 2000

Ms. Diane Easley
EPA Project Coordinator
United States Environmental Protection Agency
Superfund Division
726 Minnesota Avenue
Kansas City, Kansas 66101

Enhanced Groundwater Remediation
Progress Report
U.S. v. Lindsay Manufacturing Company
C.A. 8:92-00015
D&M Job No.: 16657-002-005

Dear Ms. Easley:

Lindsay Manufacturing Company is pleased to submit this Enhanced Groundwater Remediation Progress Report summarizing the Consent Decree items completed or undertaken during the period from October 1, 1999 to March 31, 2000. This report presents a summary of groundwater remedial pumping and analytical results from the forty-fourth and forty-fifth quarterly rounds of groundwater sampling.

Remedial Pumping

During the forty-fourth and forty-fifth quarters, monitoring well 89-12 was the only well operated within the interceptor system. Pumping at this well was conducted in October and November 1999. The system was shutdown on November 22, 1999 and restarted on March 6, 2000. Monthly summaries of total gallons pumped are presented in Table 1.

Groundwater Monitoring

Groundwater samples were collected in November 1999 (forty-fourth quarter) and February 2000 (forty-fifth quarter). A summary of wells sampled and the analytical program is presented in Table 2. Samples were analyzed for volatile organic compounds (VOCs), metals and sulfate. Field measurements for pH, temperature and specific conductivity were collected at the time of sample collection. Per request from the State of Nebraska, samples collected during the forty-fifth quarter were also analyzed for alkalinity (carbonate, bicarbonate, and hydroxide components). Laboratory analytical results and field measurements are summarized in Tables 3, 4 and 5. Copies of data validation memoranda and laboratory data pages are included in the attachment to this report.

Sample analytical data were compared to federal maximum contaminant levels (MCLs) and secondary MCLs where available as described below. Analytical anomalies were not identified during the data validation process with one exception. The pH measurements of samples collected in February 2000 were not comparable from field to fixed laboratory. The fixed laboratory results were more comparable to historical data and are used for the purposes of the following discussion.

Perched Sand Channel

Zinc, cadmium, iron, and sulfate concentrations detected in groundwater from well 89-14 during the forty-fourth and forty-fifth quarters were above the associated MCLs. The concentration of zinc (40 mg/L) and iron (5.72 mg/L) detected at well 89-14 in November 1999 (forty-fourth quarter) was greater than the levels detected during the previous quarter (18.9 mg/L and 3.20 mg/L, respectively). The levels decreased in the sample collected in February 2000 (22.3 mg/L zinc and 3.96 mg/L iron). The pH at 89-14 ranged from 4.6 to 5.3 S.U. Metals and sulfate were not analyzed in samples collected from well 89-13. Alkalinity in samples collected from wells 89-13 and 89-14 was 220 mg/L and 6.2 mg/L, respectively and consisted exclusively of the bicarbonate component.

1,1-Dichloroethene (1,1-DCE) and tetrachloroethene (PCE) were detected above the MCLs in samples collected from well 89-14. PCE was detected above the MCL in samples collected from well 89-13. Other VOCs were either not detected or their concentrations were below the MCLs. Concentrations of VOCs detected at well 89-14 increased in November 1999 above previous quarters but decreased in February 2000 to levels typically detected in previous quarters. The concentration of VOCs detected at well 89-13 continually decreased from the forty-third quarter (39 ug/L) to the forty-fourth quarter (13 ug/L) and forty-fifth quarter (9 ug/L).

Sand and Gravel Aquifer

Concentrations of metals and sulfate detected in wells completed in the sand and gravel aquifer were below MCLs with the exception of groundwater collected from wells 89-15, 92-3A, 92-3B and the AOI well only. Zinc, sulfate and iron were above the secondary MCLs in groundwater collected from well 89-15 during both sampling rounds. Chromium and iron were above MCLs in groundwater collected from 92-3A in January 2000. Sulfate was above the MCL in well 92-3B. Iron was just above the MCL in the sample collected from the AOI well during the forty-fifth quarter. The pH ranged from 6.1 to 7.1 in groundwater samples collected from the aquifer. Alkalinity ranged from 150 mg/L to 460 mg/L and existed exclusively as the bicarbonate component.

1,1-DCE, 1,1,1-trichloroethane (TCA), PCE and 1,1-dichloroethane (1,1-DCA) were detected in several wells during both quarterly sampling rounds. 1,1-DCE and PCE were above MCLs where detected. Concentrations above MCLs were detected in samples collected from wells 87-3, 89-12, 89-15, 92-3A, 92-3B, and OI Well. 1,1,1-TCA was below the MCL where detected and regulatory guidance currently is not established for 1,1-DCA.

The Preister Domestic well was sampled both before ("Before") and after ("After") treatment (November, 1999). 1,1-DCE, 1,1-DCA, 1,1,1-TCA, and PCE were detected in the "Before" sample. 1,1-DCE, 1,1-DCA, and 1,1,1-TCA were detected in the "After" sample. The concentration of 1,1-DCE (9 ug/L) was just above the MCL (7 ug/L). Samples were collected in January 2000 and VOCs were not detected in the "After" sample above the MCLs. As part of the forty-fifth quarterly sampling, samples were collected at the Preister's Domestic well in February 2000. VOCs were not detected in the "Before" sample. However, analytical results for the "After" sample showed detected concentrations for 1,1-DCE and PCE above the

respective MCLs. Additionally, 1,1-DCA and 1,1,1-TCA were detected. It appears the before and after samples were reversed. Samples were collected on March 13, 2000 with similar results but the concentrations in the "Before" sample had increased. After a treatment system review, samples were collected on April 13, 2000. Results from the "Before" sample indicate concentrations above MCLs for 1,1-DCE and PCE. Results from the "After" sample indicate concentrations below the "Before" sample but 1,1-DCE (7 ug/L) and PCE (7 ug/L) are both slightly above the MCLs (5 ug/L). Corrective action is currently in process.

Conclusions and Recommendations

The areas of exceedance of cleanup criteria are intermittent defined along an axis from source area to the down gradient terminus. The distribution of total residual organic compounds in the aquifer occurs in zones along a northwest to southeast trend with occurrences near wells 89-15, 89-12, OI well, 87-3, 92-3A, 92-3B and the Preister Domestic well. No significant deviations occurred during the forty-fourth and forty-fifth quarters in this trend, evidence of the control of the ambient flow of groundwater and capture by interceptor and irrigation wells along this axis.

We recommend the on-site groundwater remediation continue through the seasonal pumping of well 89-12. Off property groundwater remediation by attenuation through the normal seasonal irrigation pumping of the surrounding irrigation wells is an appropriate final remedy.

If you have any questions regarding this Enhanced Groundwater Remediation Progress Report, please do not hesitate to call me at your convenience.

Very truly yours,

URS/DAMES & MOORE

Roy W. Elliott

Project Coordinator

Table 1
Summary of Pumping Volumes and pH
Forty-Fourth and Forty-Fifth Quarters
October 1, 1999 through March 31, 2000
Lindsay Manufacturing Company

	TIW		AOIW		OIW		MW 89-12		Total
	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Gallons
Monthly Summary									
October-99	0	NA	0	NA	0	NA	2,494,167	NA	2,494,167
November-99	0	NA	0	5.9	0	6.5	2,216,561	6.4	2,216,561
December-99	0	NA	0	NA	0	NA	0	NA	0
January-00	0	NA	0	NA	0	NA	0	NA	0
February-00	0	NA	0	*	0	*	0	*	0
March-00	0	NA	0	NA	0	NA	1,704,517	NA	1,704,517
44th Quarter									
October, November, December 1999	0	NA	0	5.9	0	6.5	4,710,728	6.4	
45th Quarter									
January, February, March 2000	0	NA	0	*	0	*	1,704,517	*	
44th and 45th Quarters	0	NA	0		0		6,415,245		6,415,245

NA Not Applicable or Not Analyzed

* Field and laboratory pH measurements were not comparable. See Tables 3 and 4.

Table 2
Summary of Wells Sampled and Analytical Plan
Forty-Fourth and Forty-Fifth Quarterly Sampling Rounds
October 1, 1999 through March 31, 2000
Lindsay Manufacturing Company

Well ID	pH (lab) (EPA Method 150.1)	Volatile Organic Compounds (EPA Method 8260)	Total Zinc (CLP Method)	Sulfate (EPA Method 375.2)	Total Cadmium (CLP Method)	Total Chromium (CLP Method)	Total Iron (CLP Method)	Total Lead (CLP Method)	Alkalinity (SM 2320)
Samples Collected November 1999 (Forty-Fourth Quarter)									
87-3	X	X	X	X	X	X	X	X	
89-12		X							
89-13		X							
89-14	X	X	X	X		X	X		
89-15	X	X	X	X	X		X		
92-3A	X	X	X	X	X	X	X	X	
92-3B	X	X	X	X	X	X	X	X	
AOI Well		X							
OI Well		X							
Preister's Domestic (Before)		X							
Preister's Domestic (After)		X							
Samples Collected January 2000									
Preister's Domestic (Before)	X	X	X	X	X	X	X	X	
Preister's Domestic (After)		X							
Samples Collected February 2000 (Forty-Fifth Quarter)									
87-3	X	X	X	X	X	X	X	X	X
89-12		X							X
89-13		X							X
89-14	X	X	X	X	X	X	X	X	X
89-15	X	X	X	X	X	X	X	X	X
92-3A		X							X
92-3B		X							X
AOI Well	X	X	X	X	X	X	X	X	X
OI Well		X							X
Preister's Domestic (Before)	X	X	X	X	X	X	X	X	X
Preister's Domestic (After)	X	X	X	X	X	X	X	X	
Samples Collected March 2000									
Preister's Domestic (Before)		X							
Preister's Domestic (After)		X							
Samples Collected April 2000									
Preister's Domestic (Before)		X							
Preister's Domestic (After)		X							

Table 3
Summary of Analytical Results for Inorganic Compounds
Forty-Fourth and Forty-Fifth Quarterly Sampling Rounds
October 1, 1999 through March 31, 2000
Lindsay Manufacturing Company

Well ID	Lab ID	Field Measurements				Total Metals (mg/L)					
		pH (field)	pH (lab)	Water Temperature (C°) (field)	Specific Conductivity (umhos/cm) (field)	Zinc	Sulfate	Cadmium	Chromium	Iron	Lead
Federal MCL		6.5-8.5*	6.5-8.5*	NS	NS	5.0*	250*	0.005	0.05	0.3*	0.05
Historical Data:											
Old Lindsay Public Supply Well (Sampled January 1977)		NA	7.4	NA	NA	NA	NA	NA	NA	NA	NA
Old Lindsay Public Supply Well (Sampled 01/28/83)		NA	7.2	NA	NA	NA	NA	NA	NA	NA	NA
15261 (Sampled 01/28/83)		NA	7.0	NA	NA	0.11	3.1	U	U	NA	U
15262 (Sampled 01/28/83)		NA	7.1	NA	NA	0.11	14.0	U	U	NA	U
Samples Collected November 1999 (Forty-Fourth Quarter)											
87-3	99-17105-AZ15F	6.6	6.6 J	13.1	770	0.215	30	0.002 U	0.009	0.15	0.001 U
89-14	99-17103-AZ15D/ 99-17259-AZ49D	5.4	5.3 J	12	1,030	40.0	410	NA	0.005 U	5.72	NA
89-15	99-17104-AZ15E	6.1	6.1 J	12	1,010	30.1	300	0.003	NA	8.57	NA
92-3B	99-17257-AZ49B	6.3	6.3 J	12	1,040	0.010	380	0.002 U	0.025 J	0.22 J	0.001 U
Samples Collected January 2000											
Preister's Domestic (Before)	00-172-BE52A	6.2	6.7 J	14.9	800	0.058 J	120	0.002 U	0.005 U	0.02 U	0.006
92-3A	00-172-BE52C	6.9	6.9 J	10.7	450	0.018 J	18	0.002 U	0.065	0.92	0.002
Samples Collected February 2000 (Forty-Fifth Quarter)											
87-3	00-1806-BH54F	5.4	6.7 J	11.6	821	0.143	26	0.002 U	0.010	0.20 J	0.001 U
89-14	00-1808-BH54H	5.9	4.6 J	12.1	1,124	22.3	410	0.007	0.005 U	3.96 J	0.001 U
89-15	00-1807-BH54G	4.2	6.3 J	11.3	1,165	38.9	310	0.003	0.008	7.26 J	0.001
AOI Well	00-1809-BH54I	4.5	6.4 J	13.8	383	2.44	41	0.002 U	0.005 U	0.31 J	0.001
Preister's Domestic (Before)	00-1804-BH54D	5.0	7.1 J	12.5	958	2.72	150	0.002 U	0.005 U	0.02 UJ	0.005
Preister's Domestic (After)	00-1805-BH54E	5.1	7.1 J	13.2	947	0.102	150	0.002 U	0.005 U	0.17 J	0.008

Notes:
* EPA secondary MCLs
NA = Not Analyzed
ND = Not Detected
NS = No Standard
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
Bold font indicates result reported is above the detection limit.

Table 4
Summary of Analytical Results for Organic Compounds
Forty-Fourth and Forty-Fifth Quarterly Sampling Rounds
October 1, 1999 through March 31, 2000
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
State MCL						reserved	NS	NS	reserved	reserved	NS	reserved	-
EPA MCL						7	NS	170	5	200	5	5	-
Samples Collected November 1999, (Forty-Fourth Quarter)													
87-3	99-17105-AZ15F	6.6	6.6 J	13.1	770	14	5 U	5 U	5 U	24	5 U	6	44
89-12	99-17100-AZ15A	6.4	NA	12.6	730	40	16	5 U	5 U	110	5 U	250	416
89-13	99-17102-AZ15C	7.4	NA	11.8	540	5 U	5 U	5 U	5 U	5 U	5 U	13	13
89-14	99-17103-AZ15D	5.4	5.3 J	12	1030	48	5 U	5 U	5 U	50	5 U	32	130
89-15	99-17104-AZ15E	6.1	6.1 J	12	1010	54	5 U	5 U	5 U	74	5 U	44	172
92-3A	99-17256-AZ49A	6.7	NA	11.6	530	15	5 U	5 U	5 U	74	5 U	30	119
92-3B	99-17257-AZ49B	6.3	6.3 J	12	1040	26	5 U	5 U	5 U	74	5 U	30	130
AOI Well	99-17109-AZ15J	5.9	NA	12.3	440	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	99-17101-AZ15B	6.5	NA	11.5	650	5 U	5 U	5 U	5 U	5 U	5 U	10	10
Preister's Domestic (before)	99-17107-AZ15H	6.4	NA	18.2	820	28	6	5 U	5 U	56	5 U	44	134
Preister's Domestic (after)	99-17108-AZ15I	6.8	NA	14.3	840	9	7	5 U	5 U	23	5 U	5 U	39
Samples Collected January 2000													
Preister's Domestic (before)	00-172-BE52A	6.2	6.7 J	14.9	800	30	5 U	5 U	5 U	59	5 U	37	126
Preister's Domestic (after)	00-173-BE52B	6.1	NA	15.5	830	5 U	5 U	5 U	5 U	7	5 U	5 U	7

Notes:
NA = Not Analyzed
ND = Not Detected
NS = No Standard
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
Bold font indicates result reported is above the detection limit.

Table 4
Summary of Analytical Results for Organic Compounds
Forty-Fourth and Forty-Fifth Quarterly Sampling Rounds
October 1, 1999 through March 31, 2000
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
State MCL						reserved	NS	NS	reserved	reserved	NS	reserved	-
EPA MCL						7	NS	170	5	200	5	5	-
Samples Collected February 2000 (Forty-Fifth Quarter)													
87-3	00-1806-BH54F	5.4	6.7 J	11.6	821	10	5 U	5 U	5 U	25	5 U	5 U	35
89-12	00-1802-BH54B	5.3	NA	12.4	966	13	5 U	5 U	5 U	20	5 U	35	68
89-13	00-1803-BH54C	5.5	NA	11.0	541	5 U	5 U	5 U	5 U	5 U	5 U	9	9
89-14	00-1808-BH54H	5.9	4.6 J	12.1	1,124	32	5 U	5 U	5 U	35	5 U	21	88
89-15	00-1807-BH54G	4.2	6.3 J	11.3	1,165	110	6	5 U	5 U	140	5 U	82	338
92-3A	00-1899-BH69A	6.2	NA	10.6	580	9	5 U	5 U	5 U	38	5 U	16	63
92-3B	00-1900-BH69B	5.9	NA	10.4	790	16	5 U	5 U	5 U	100	5 U	41	157
AOI Well	00-1809-BH54I	4.5	6.4 J	13.8	383	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	00-1801-BH54A	6.6	NA	11.1	648	12	5 U	5 U	5 U	5 U	5 U	21	33
Preister's Domestic (Before)	00-1804-BH54D	5.0	7.1 J	12.5	958	5 U	5 U	5 U	5 U	5 U	5 U	5 U*	ND
Preister's Domestic (After)	00-1805-BH54E	5.1	7.1 J	13.2	947	49	6	5 U	5 U	94	5 U	55*	149
Samples Collected March 2000													
Preister's Domestic (Before)	00-3391-BJ97B		NA			6	5 U	5 U	5 U	13	5 U	6	25
Preister's Domestic (After)	00-3390-BJ97A		NA			56	7	5 U	5 U	130	5 U	65	258
Samples Collected April 2000													
Preister's Domestic (Before)	00-5529-BN28A		NA			65	7	5 U	5 U	140	5 U	62	274
Preister's Domestic (After)	00-5530-BN28B		NA			7	5 U	5 U	5 U	14	5 U	7	28

Notes:
NA = Not Analyzed
ND = Not Detected
NS = No Standard
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
* Results from Preister's Domestic wells (before and after) are reported to be reversed for the February 2000 sampling round.
Bold font indicates result reported is above the detection limit.

Table 5
Summary of Analytical Results for Alkalinity
Forty-Fourth and Forty-Fifth Quarterly Sampling Rounds
October 1, 1999 through March 31, 2000
Lindsay Manufacturing Company

Well ID	Lab ID	Field Measurements					Alkalinity (mg/L)			
		pH (field)	pH (lab)	Water Temperature (C^{O}) (field)	Specific Conductivity (umhos/cm) (field)	Sulfate (mg/L)	Total Alkalinity	Carbonate	Bicarbonate	Hydroxide
Samples Collected February 2000 (Forty-Fifth Quarter)										
87-3	00-1806-BH54F	5.4	6.7 J	11.6	821	26	300	1.0 U	300	1.0 U
89-12	00-1802-BH54B	5.3	NA	12.4	966	NA	460	1.0 U	460	1.0 U
89-13	00-1803-BH54C	5.5	NA	11.0	541	NA	220	1.0 U	220	1.0 U
89-14	00-1808-BH54H	5.9	4.6 J	12.1	1,124	410	6.2	1.0 U	6.2	1.0 U
89-15	00-1807-BH54G	4.2	6.3 J	11.3	1,165	310	180	1.0 U	180	1.0 U
92-3A	00-1899-BH69A	6.2	NA	10.6	580	NA	220	1.0 U	220	1.0 U
92-3B	00-1900-BH69B	5.9	NA	10.4	790	NA	200	1.0 U	200	1.0 U
AOI Well	00-1809-BH54I	4.5	6.4 J	13.8	383	41	150	1.0 U	150	1.0 U
OI Well	00-1801-BH54A	6.6	NA	11.1	648	NA	220	1.0 U	220	1.0 U
Preister's Domestic (Before)	00-1804-BH54D	5.0	7.1 J	12.5	958	150	320	1.0 U	320	1.0 U

Notes:
NA = Not Analyzed
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.

URS

BIANNUAL REPORT ENHANCED GROUNDWATER REMEDIATION PROGRESS PERIOD COVERING APRIL 1, 2000 TO SEPTEMBER 30, 2000 LINDSAY MANUFACTURING COMPANY

For

U.S. ENVIRONMENTAL PROTECTION AGENCY
URS JOB NO.: 16657-002-005
October 20, 2000

URS Corporation
500 Market Place Tower
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Tel: 206.728.0744
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URS

October 20, 2000

Ms. Diane Easley
EPA Project Coordinator
United States Environmental Protection Agency
Superfund Division
726 Minnesota Avenue
Kansas City, Kansas 66101

Enhanced Groundwater Remediation
Progress Report
U.S. v. Lindsay Manufacturing Company
C.A. 8:92-00015
URS Job No.: 16657-002-005

Dear Ms. Easley:

Lindsay Manufacturing Company is pleased to submit this Enhanced Groundwater Remediation Progress Report summarizing the Consent Decree items completed or undertaken during the period from April 1, 2000 to September 30, 2000. This report presents a summary of groundwater remedial pumping and analytical results from the forty-sixth (May 2000) and forty-seventh (August 2000) quarterly rounds of groundwater sampling.

REMEDIAL PUMPING

During the forty-sixth and forty-seventh quarters, monitoring well 89-12 was the only well operated within the interceptor system. Pumping at this well was conducted from April through September 2000 with occasional shutdowns for maintenance or due to lowered water levels during seasonal irrigation stresses on the water table in the area. Monthly summaries of total gallons pumped are presented in Table 1. The daily record for pumping from April through June 2000 was not available. Data were available for April 3 and June 29, 2000. An average pumping volume for April, May and June was calculated from the available data and is provided in Table 1.

The three irrigation wells at and surrounding the down gradient terminus of the residuum pumped from April to September. The total pumped this season was 94,455,030 gallons. This represents 54% of the enhanced remedial pumping in 1993 and exceeds the actual pumping rate of the TIW.

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GROUNDWATER MONITORING

Groundwater samples were collected in May 2000 (forty-sixth quarter) and August 2000 (forty-seventh quarter). A summary of wells sampled and the analytical program is presented in Table 2. Samples were analyzed for volatile organic compounds (VOCs), metals and sulfate. Field measurements for pH, temperature and specific conductivity were collected at the time of sample collection. Per request from the State of Nebraska, samples collected during the forty-sixth quarter were also analyzed for alkalinity. Laboratory analytical results and field measurements are summarized in Tables 3, 4 and 5. Copies of data validation memoranda and laboratory data pages are included in the attachment to this report.

Sample analytical data were compared to federal maximum contaminant levels (MCLs) and secondary MCLs where available as described below. Analytical anomalies were not identified during the data validation process with the exception that samples requested for alkalinity were analyzed only for the carbonate and bicarbonate components. The hydroxide component was omitted. Additionally, the field data collected from April, May and July 2000 was not available and is not included in this report.

PERCHED SAND CHANNEL

Zinc, cadmium, iron, and sulfate concentrations detected in groundwater from well 89-14 during the forty-sixth and forty-seventh quarters were above the associated primary and secondary MCLs. The concentrations of these compounds increased from the forty-fifth quarter to the forty-sixth quarter followed by a decrease from the forty-sixth to the forty-seventh quarter. The pH at 89-14 ranged from 4.8 to 5.8 SU, similar to previous quarters. Alkalinity at 89-14 was < 1.0 mg/L.

Metals and sulfate were not analyzed in samples collected from well 89-13 during the forty-sixth and forty-seventh quarters. Alkalinity in the sample collected from well 89-13 during the forty-sixth quarter was 220 mg/L and consisted exclusively of the bicarbonate component.

Tetrachloroethene (PCE) was detected above the MCL in samples collected from wells 89-13 and 89-14 during both the forty-sixth and forty-seventh quarters. 1,1-DCE was detected above the MCL in samples collected from well 89-14 during both quarters. Other VOCs were either not detected or their concentrations were below the MCLs. The concentration of VOCs detected at wells 89-13 and 89-14 increased from the forty-fifth to the forty-sixth quarter then decreased during the forty-seventh quarter to levels similar to the forty-fifth quarter.

SAND AND GRAVEL AQUIFER

Concentrations of metals and sulfate detected in wells completed in the sand and gravel aquifer were below MCLs with the exception of groundwater collected from wells 89-15, 92-3A, 92-3B and the OIW. Zinc, sulfate and iron were above the secondary MCLs in groundwater collected from well 89-15 during both sampling rounds. Cadmium was above the MCL in the sample collected from well 89-15 during the forty-seventy quarter. Iron was above the MCL in samples collected from wells 92-3A and 92-3B during both quarters and the OIW in the forty-sixth quarter. Chromium was above the MCL in well sample 92-3A collected in May 2000 and well sample 92-3B collected in August 2000. Sulfate was also above the MCL in the sample collected from 92-3B in August 2000. The OIW was not sampled during the forty-seventh quarter. The pH ranged from 6.1 to 7.1 in groundwater samples collected from the aquifer. Alkalinity ranged from 150 mg/L to 300 mg/L and existed exclusively as the bicarbonate component.

Iron, sulfate, and zinc concentrations are plotted for selected wells completed in the sand and gravel aquifer (Figures 2,3 and 4). These wells are located along the down-gradient path of the original plume transport pathway from the source area to the monitoring wells MW92-3A&B (Figure 1). The curves demonstrate the aquifer recovery during and after the pumping of the interceptor wells.

1,1-Dichloroethene (1,1-DCE), 1,1,1-trichloroethane (TCA), tetrachloroethene (PCE) and 1,1-dichloroethane (1,1-DCA) were detected in several wells during both quarterly sampling rounds. 1,1-DCE and/or PCE were above MCLs in wells 87-3, 89-12, OIW, and 89-15 during both quarterly sampling rounds. PCE was also detected above the MCLs in samples collected from wells 92-3A and 92-3B during both quarters. 1;1-DCE was equal to the MCL in the sample collected from 92-3B in August 2000.

1,1,1-TCA (540 ug/L) was detected above the MCL (200 ug/L) in the sample collected from 89-15 in August 2000. Concentrations of 1,1,1-TCA detected in other wells were below the MCL. A MCL has not been established for 1,1-DCA. A single detection of 1,2-dichloroethene (1,2-DCE) in the sample collected from 89-15 in August 2000 was below the MCL. Trichloroethene and 1,2-dichloroethane were not detected.

Samples were collected from the Preister Domestic Wells on April 13, 2000. These results were provided previously in the biannual report submitted to EPA on May 24, 2000 and are summarized in Table 4 of this report. Results from the "Before" sample showed concentrations above MCLs for 1,1-DCE and PCE. Results from the "After" sample indicated concentrations below the "Before" sample but 1,1-DCE (7 ug/L)

and PCE (7 ug/L) were both slightly above the MCLs (5 ug/L). Corrective actions were implemented and samples were collected in May and July 2000. Concentrations of 1,1-DCE and/or PCE were above MCLs in the "After" treatment samples for both sampling rounds. Additional corrective actions were implemented and the well was resampled during the forty-seventh quarterly sampling round in August 2000. 1,1-DCE, 1,1,1-TCA and PCE were detected in the "After" treatment sample; however, all of the concentrations were below the associated MCLs. Inorganic analyses were performed on samples collected from the Preister well in August 2000. Metals and sulfate did not exceed MCLs.

Total organic compounds detected in selected monitoring wells along the original path of the plume are presented on Figure 5. The trend through time is downward in well MW92-3B after 1996. This trend is in part due to the increasing attenuation provided by the drought and the consequent irrigation well pumping.

CONCLUSIONS AND RECOMMENDATIONS

Substantial progress in aquifer restoration has been made since the cessation of interception well pumping in the mid 1990's. The attenuation effect of irrigation well groundwater extraction along the axis of the residuum has reduced the residual concentrations. This is demonstrated in the graphs of zinc, iron and sulfate concentrations in monitoring well samples (Figures 2, 3 and 4). During the summer of 2000, drought conditions increased the irrigation well pumping and increased the attenuation effects of the local irrigation wells on the residuum. The summer 2000 irrigation wells groundwater interception exceeded 94 million gallons. This exceeded the annual TIW pumping rate of the mid 1990s. The limited areas of residual exceedance of cleanup criteria are intermittent defined along an axis from source area to the down gradient terminus. This terminus is controlled by three irrigation wells and monitored through sampling of monitoring wells MW89-3A and B and the Preister domestic well.

The distribution of total residual organic compounds in the aquifer occurs in zones along a northwest to southeast trend with occurrences near wells 89-15, 89-12, OIW (source area wells), 92-3A, 92-3B and the Preister Domestic well (down gradient wells). No significant deviations occurred during the forty-sixth and forty-seventh quarters in this trend. There is evidence of the control of the ambient flow of groundwater and capture by interceptor and irrigation wells along this axis.

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With the exception of seasonal exceedances at MW89-15 which are demonstrated to attenuate below MCLs as the aquifer waters flows down-gradient through the other monitoring wells, the residuum is being removed from the aquifer on a seasonal basis by the irrigation well attenuation and ultimate extraction. The exceedances at MW89-15 will gradually decline with the annual flushing process of the upward and downward flow of groundwater into and out of the overlying aquitard. This piston like action is caused by the seasonal irrigation well influence on the vicinity aquifer pressure head. This potentiometric rise and fall in the aquifer water levels was demonstrated in the Remedial Investigation and continues annually. Given these influences and the demonstration of the attenuation of the residual organic compounds we recommend the on-site groundwater remediation at MW89-12 be continued seasonally (June to Sept) and confirmation monitoring continue. The off property groundwater remediation by attenuation through the normal seasonal irrigation pumping of the surrounding irrigation wells is as appropriate final remedy.

If you have any questions regarding this Enhanced Groundwater Remediation Progress Report, please do not hesitate to call me at your convenience.

Very truly yours,

URS CORPORATION

Roy W. Elliott
Project Coordinator

Table 1
Summary of Pumping Volumes and pH
Forty-Sixth and Forty-Seventh Quarters
April 1, 2000 through September 30, 2000
Lindsay Manufacturing Company

	TIW		AOIW		OIW		MW 89-12		Total
	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Gallons
Monthly Summary									
April-00	0	NA	0	NA	0	NA	2,634,701 *	NA	2,634,701 *
May-00	0	NA	0	6.4	0	6.8	2,634,701 *	NA	2,634,701 *
June-00	0	NA	0	NA	0	NA	2,634,701 *	NA	2,634,701 *
July-00	0	NA	0	NA	0	NA	2,135,213	NA	2,135,213
August-00	0	NA	0	6.3	0	6.6	1,763,512	6.5	1,763,512
September-00	0	NA	0	NA	0	NA	1,583,695	NA	1,583,695
46th Quarter									
April, May, June 2000	0	NA	0	6.4	0	6.8	7,904,104	NA	7,904,104
47th Quarter									
July, August, September 2000	0	NA	0	6.3	0	6.6	5,482,420	6.5	5,482,420
46th and 47th Quarters	0	NA	0		0		13,386,524		13,386,524

NA Not Applicable or Not Analyzed

* Daily Records for April, May and June were not available. Gallons pumped that are shown are based on total gallons pumped from April 3 to June 29, 2000.

Table 2
Summary of Wells Sampled and Analytical Plan
Forty-Sixth and Forty-Seventh Quarterly Sampling Rounds
April 1, 2000 through September 30, 2000
Lindsay Manufacturing Company

Well ID	pH (lab) (EPA Method 150.1)	Volatile Organic Compounds (EPA Method 8260)	Total Zinc (CLP Method)	Sulfate (EPA Method 375.2)	Total Cadmium (CLP Method)	Total Chromium (CLP Method)	Total Iron (CLP Method)	Total Lead (CLP Method)	Alkalinity (SM 2320)
Samples Collected April 2000									
Preister's Domestic (Before)		X							
Preister's Domestic (After)		X							
Samples Collected May 2000									
87-3	X	X	X	X	X	X	X	X	X
89-12		X							X
89-13		X							X
89-14	X	X	X	X	X	X	X	X	X
89-15	X	X	X	X	X	X	X	X	X
92-3A	X	X	X	X	X	X	X	X	X
92-3B	X	X	X	X	X	X	X	X	X
AOI Well	X	X	X	X	X	X	X	X	X
OI Well	X	X	X	X	X	X	X	X	X
Preister's Domestic (Before)	X	X	X	X	X	X	X	X	X
Preister's Domestic (After)	X	X	X	X	X	X	X	X	
Sample Collected July 2000									
Preister's Domestic (Before)	X	X	X	X	X	X	X	X	
Preister's Domestic (After)	X	X	X	X	X	X	X	X	
Samples Collected August 2000									
87-3	X	X	X	X	X	X	X	X	
89-12		X							
89-13		X							
89-14	X	X	X	X	X	X	X	X	
89-15	X	X	X	X	X	X	X	X	
92-3A	X	X	X	X	X	X	X	X	
92-3B	X	X	X	X	X	X	X	X	
AOI Well		X							
OI Well		X							
Preister's Domestic (Before)	X	X	X	X	X	X	X	X	
Preister's Domestic (After)	X	X	X	X	X	X	X	X	

Table 3
Summary of Analytical Results for Inorganic Compounds
Forty-Sixth and Forty-Seventh Quarterly Sampling Rounds
April 1, 2000 through September 30, 2000
Lindsay Manufacturing Company

Well ID	Lab ID	Field Measurements				Total Metals (mg/L)					
		pH (field)	pH (lab)	Water Temperature (C°) (field)	Specific Conductivity (umhos/cm) (field)	Zinc	Sulfate	Cadmium	Chromium	Iron	Lead
Federal MCL		6.5-8.5*	6.5-8.5*	NS	NS	5.0*	250*	0.005	0.05	0.3*	0.05
Historical Data:											
Old Lindsay Public Supply Well (Sampled January 1977)		NA	7.4	NA	NA	NA	NA	NA	NA	NA	NA
Old Lindsay Public Supply Well (Sampled 01/28/83)		NA	7.2	NA	NA	NA	NA	NA	NA	NA	NA
15261 (Sampled 01/28/83)		NA	7.0	NA	NA	0.11	3.1	U	U	NA	U
15262 (Sampled 01/28/83)		NA	7.1	NA	NA	0.11	14.0	U	U	NA	U
Samples Collected May 2000											
87-3	00-7614-BQ74C	NA	6.68 J	NA	NA	0.167	28	0.002 U	0.007	0.22	0.001 U
89-14	00-7622-BQ74K	NA	4.81 J	NA	NA	26.2	510	0.009	0.005 U	4.15	0.002 U
89-15	00-7621-BQ74J	NA	6.09 J	NA	NA	40.4	340	0.004	0.011	6.97	0.001 U
92-3A	00-7615-BQ74D	NA	7.02 J	NA	NA	0.016	22	0.002 U	0.052	3.17	0.002
92-3B	00-7616-BQ74E	NA	6.69 J	NA	NA	0.008	170	0.002 U	0.036	0.97	0.001 U
AOI Well	00-7612-BQ74A	NA	6.39 J	NA	NA	2.39	35	0.002 U	0.005 U	0.12	0.001
OI Well	00-7619-BQ74H	NA	6.75 J	NA	NA	6.74	110	0.002 U	0.007	10.9	0.001 U
Preister's Domestic (Before)	00-7624-BQ74M	NA	7.04 J	NA	NA	0.029	240	0.002 U	0.005 U	0.02 U	0.001 U
Preister's Domestic (After)	00-7625-BQ74N	NA	7.17 J	NA	NA	3.22	230	0.002 U	0.005 U	0.02 U	0.001 U
Samples Collected July 2000											
Preister's Domestic (Before)	00-11906-BW79A	NA	7.3 J	NA	NA	0.013	180	0.002 U	0.005 U	0.02 U	0.003
Preister's Domestic (After)	00-11907-BW79B	NA	7.4 J	NA	NA	0.018	180	0.002 U	0.005 U	0.02 U	0.002
Samples Collected August 2000											
87-3	00-13897-BZ90G	6.45	6.4 J	12.8	680	1.42	54	0.002 U	0.009	0.22	0.001 U
89-14	00-13896-BZ90F	6.35	5.8 J	13.1	1,230	17.6	370	0.006	0.005	1.89	0.001 U
89-15	00-13895-BZ90E	5.39	5.1 J	12.5	1,960	76.2	800	0.008	0.018	38.1	0.002 U
92-3A	00-13898-BZ90H	6.90	7.0 J	11.7	580	0.025	21	0.002 U	0.035	0.85	0.001
92-3B	00-13899-BZ90I	6.52	6.5 J	12.1	1,080	0.013	300	0.002 U	0.124	1.79	0.002
Preister's Domestic (Before)	00-13966-CA07A	6.79	7.0 J	16.3	920	0.020	89	0.002 U	0.005 U	0.02 U	0.002
Preister's Domestic (After)	00-13967-CA07B	6.91	7.1 J	16.2	430	0.012	79	0.002 U	0.005 U	0.02 U	0.001 U

Notes:
* EPA secondary MCLs
NA = Not Analyzed or Not Available
ND = Not Detected NS = No Standard
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
Bold font indicates result reported is above or equal to the MCL.

Table 4
Summary of Analytical Results for Organic Compounds
Forty-Sixth and Forty-Seventh Quarterly Sampling Rounds
April 1, 2000 through September 30, 2000
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C°) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
State MCL						reserved	NS	NS	reserved	reserved	NS	reserved	-
EPA MCL						7	NS	170	5	200	5	5	-
Samples Collected April 2000													
Preister's Domestic (Before)	00-5529-BN28A	NA	NA	NA	NA	65	7	5 U	5 U	140	5 U	62	274
Preister's Domestic (After)	00-5530-BN28B	NA	NA	NA	NA	7	5 U	5 U	5 U	14	5 U	7	28
Samples Collected May 2000													
87-3	00-7614-BQ74C	NA	6.68 J	NA	NA	10	5 U	5 U	5 U	27	5 U	5 U	37
89-12	00-7620-BQ74I	NA	NA	NA	NA	20	5	5 U	5 U	57	5 U	60	142
89-13	00-7623-BQ74L	NA	NA	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	23	23
89-14	00-7622-BQ74K	NA	4.81 J	NA	NA	40	5 U	5 U	5 U	54	5 U	20	114
89-15	00-7621-BQ74J	NA	6.09 J	NA	NA	97	7	5 U	5 U	140	5 U	71	315
92-3A	00-7615-BQ74D	NA	7.02 J	NA	NA	6	5 U	5 U	5 U	88	5 U	32	126
92-3B	00-7616-BQ74E	NA	6.69 J	NA	NA	5 U	5 U	5 U	5 U	14	5 U	7	21
AOI Well	00-7612-BQ74A	NA	6.39 J	NA	NA	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	00-7619-BQ74H	NA	6.75 J	NA	NA	18	5 U	5 U	5 U	5 U	5 U	26	44
Preister's Domestic (Before)	00-7624-BQ74M	NA	7.04 J	NA	NA	75	7	5 U	5 U	170	5 U	69	321
Preister's Domestic (After)	00-7625-BQ74N	NA	7.17 J	NA	NA	17	7	5 U	5 U	86	5 U	5 U	110

Notes:
NA = Not Analyzed or Not Available
ND = Not Detected
NS = No Standard
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
Shaded cells indicate information is pending.
Bold font indicates result reported is above or equal to the MCL.

Table 4
Summary of Analytical Results for Organic Compounds
Forty-Sixth and Forty-Seventh Quarterly Sampling Rounds
April 1, 2000 through September 30, 2000
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C°) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
State MCL						reserved	NS	NS	reserved	reserved	NS	reserved	-
EPA MCL						7	NS	170	5	200	5	5	-
Samples Collected July 2000													
Preister's Domestic (Before)	00-11906-BW79A	NA	NA	NA	NA	**71**	6	5 U	5 U	150	5 U	**70**	297
Preister's Domestic (After)	00-11907-BW79B	NA	NA	NA	NA	**9**	5 U	5 U	5 U	21	5 U	**10**	40
Samples Collected August 2000													
87-3	00-13897-BZ90G	6.45	6.4 J	12.8	680	**7**	5 U	5 U	5 U	15	5 U	5 U	22
89-12	00-13892-BZ90B	6.51	NA	11.9	908	**35**	28	5 U	5 U	48	5 U	**230**	341
89-13	00-13893-BZ90C	7.52	NA	14.1	570	5 U	5 U	5 U	5 U	5 U	5 U	**13**	13
89-14	00-13896-BZ90F	6.35	5.8 J	13.1	1,230	**31**	5 U	5 U	5 U	44	5 U	**18**	93
89-15	00-13895-BZ90E	5.39	5.1 J	12.5	1,960	**230**	56	19	5 U	**520**	5 U	**170**	995
92-3A	00-13898-BZ90H	6.90	7.0 J	11.7	580	5 U	5 U	5 U	5 U	52	5 U	**22**	74
92-3B	00-13899-BZ90I	6.52	6.5 J	12.1	1,080	**7**	5 U	5 U	5 U	42	5 U	**21**	70
AOI Well	00-13894-BZ90D	6.32	NA	11.2	510	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	00-13891-BZ90A	6.58	NA	11.0	1,000	**22**	5 U	5 U	5 U	29	5 U	**19**	70
Preister's Domestic (Before)	00-13966-CA07A	6.79	7.0 J	16.3	920	**26**	3.7	2.0	1 U	54	1 U	**32**	118
Preister's Domestic (After)	00-13967-CA07B	6.91	7.1 J	16.2	430	1.6	1 U	1 U	1 U	4.4	1 U	3.0	9.0

Notes:
NA = Not Analyzed or Not Available
ND = Not Detected
NS = No Standard
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
Shaded cells indicate information is pending.
Bold font indicates result reported is above or equal to the MCL.

Table 5
Summary of Analytical Results for Alkalinity
Forty-Sixth and Forty-Seventh Quarterly Sampling Rounds
April 1, 2000 through September 30, 2000
Lindsay Manufacturing Company

Well ID	Lab ID	Field Measurements					Alkalinity (mg/L)			
		pH (field)	pH (lab)	Water Temperature (C^{O}) (field)	Specific Conductivity (umhos/cm) (field)	Sulfate (mg/L)	Total Alkalinity	Carbonate	Bicarbonate	Hydroxide
Samples Collected May 2000 (Forty-Sixth Quarter)										
87-3	00-7614-BQ74C	NA	6.68 J	NA	NA	28	300	1.0 U	300	NA
89-12	00-7620-BQ74I	NA	NA	NA	NA	NA	210	1.0 U	210	NA
89-13	00-7623-BQ74L	NA	NA	NA	NA	NA	220	1.0 U	220	NA
89-14	00-7622-BQ74K	NA	4.81 J	NA	NA	510	1.0 U	1.0 U	1.0 U	NA
89-15	00-7621-BQ74J	NA	6.09 J	NA	NA	340	160	1.0 U	160	NA
92-3A	00-7615-BQ74D	NA	7.02 J	NA	NA	22	240	1.0 U	240	NA
92-3B	00-7616-BQ74E	NA	6.69 J	NA	NA	170	200	1.0 U	200	NA
AOI Well	00-7612-BQ74A	NA	6.39 J	NA	NA	35	170	1.0 U	170	NA
OI Well	00-7619-BQ74H	NA	6.75 J	NA	NA	110	230	1.0 U	230	NA
Preister's Domestic (Before)	00-7624-BQ74M	NA	7.04 J	NA	NA	240	150	1.0 U	150	NA

Notes:
NA = Not Analyzed or Not Available
Shaded cells indicate information is pending.
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.

URS

April 18, 2001

Ms. Diane Easley
EPA Project Coordinator
United States Environmental Protection Agency
Superfund Division
726 Minnesota Avenue
Kansas City, Kansas 66101

Enhanced Groundwater Remediation
Progress Report
U.S. v. Lindsay Manufacturing Company
C.A. 8:92-00015
URS Job No.: 53-16657002.00

Dear Ms. Easley:

Lindsay Manufacturing Company is pleased to submit this Enhanced Groundwater Remediation Progress Report summarizing the Consent Decree items completed or undertaken during the period from October 1, 2000 to March 31, 2001. This report presents a summary of groundwater remedial pumping and analytical results from the forty-eighth (November 2000) and forty-ninth (February 2001) quarterly rounds of groundwater sampling.

REMEDIAL PUMPING

During the forty-eighth and forty-ninth quarters, monitoring well MW89-12 was the only well operated within the interceptor system. Pumping at this well was conducted from October 1 through November 6, 2000 and then the system was shutdown for the winter. Pumping was resumed on March 12, 2001. Monthly summaries of total gallons pumped are presented in Table 1.

GROUNDWATER MONITORING

Groundwater samples were collected in November 2000 (forty-eighth quarter) and February 2001 (forty-ninth quarter). A summary of wells sampled and the analytical program is presented in Table 2. Samples were analyzed for volatile organic compounds (VOCs), metals and sulfate. Field measurements for pH, temperature and specific conductivity were collected at the time of sample collection. Laboratory analytical results and field measurements are summarized in Tables 3 and 4. Copies of data validation memoranda and laboratory data pages are included in the attachment to this report. Monitoring well locations are shown on Figure 1.

Sample analytical data for VOCs, zinc, cadmium, chromium and lead were compared to federal maximum contaminant levels (MCLs) and secondary MCLs where available as described below. Sulfate, iron and pH were compared to alternate cleanup levels agreed upon by the State of Nebraska, EPA and Lindsay Manufacturing in December 2000. Analytical anomalies were not identified during the data validation process.

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PERCHED SAND CHANNEL

Zinc concentrations in groundwater collected from monitoring well MW89-14 were slightly above the federal MCL (5.0 mg/L) during the forty-eighth and forty-ninth quarters and ranged from 11.6 to 17.0 mg/L. Cadmium was equal to the MCL (0.005 mg/L) in the forty-eighth quarter and just above the MCL in the forty-ninth quarter (0.006 mg/L). Sulfate, pH and iron were below or within the acceptable range of the newly established alternate cleanup levels for on-property wells.

Metals and sulfate were not analyzed in samples collected from well MW89-13 during the forty-eighth and forty-ninth quarters.

Tetrachloroethene (PCE) was detected above the MCL in samples collected from wells MW89-13 and MW89-14 during both the forty-eighth and forty-ninth quarters. 1,1-Dichloroethene (1,1-DCE) was detected above the MCL in the sample collected from well MW89-14 during the forty-ninth quarter. Other VOCs were either not detected or their concentrations were below the MCLs. The concentration of VOCs detected at wells MW89-13 and MW89-14 during the forty-eighth and forty-ninth quarters decreased from the previous two quarters.

SAND AND GRAVEL AQUIFER

Concentrations of zinc, cadmium, chromium and lead detected in wells completed in the sand and gravel aquifer were below MCLs with the exception of groundwater collected from wells MW89-15 and MW92-3A. Zinc in groundwater collected from well MW89-15 was above the MCL during the forty-eighth and forty-ninth quarters. Cadmium at MW89-15 was detected at a concentration equal to the MCL (0.005 mg/L) during both quarters. The alternate cleanup level for on-property wells for sulfate and iron was exceeded during the forty-eighth and forty-ninth quarters in groundwater collected from MW89-15. Chromium was above the MCL in groundwater collected from well MW92-3A during the forty-eighth quarter but decreased to well below the MCL during the forty-ninth quarter. The pH ranged from 5.9 to 7.2 in groundwater collected from the aquifer.

1,1-DCE, 1,1,1-trichloroethane (TCA) and PCE were detected in several wells during both quarterly sampling rounds. 1,1-DCE and/or PCE were above MCLs in wells MW87-3, MW89-12, MW89-15, MW92-3A, MW92-3B and OIW during both quarterly sampling rounds.

1,1,1-TCA (220 ug/L) was detected above the MCL (200 ug/L) in the sample collected from MW89-15 in November 2000. Concentrations of 1,1,1-TCA detected in other wells were below the MCL. 1,1-Dichloroethane (1,1-DCA) and 1,2-dichloroethene (1,2-DCE) were detected at MW89-15 during the forty-eighth and forty-ninth quarters. 1,2-DCE was below the MCL. A MCL has not been established for 1,1-DCA. Trichloroethene and 1,2-dichloroethane were not detected in any of the wells sampled during the forty-eighth and forty-ninth quarters.

Samples were collected from the Preister Domestic Wells during the forty-eighth and forty-ninth quarters. Results from the "Before" (pre-treatment) sample showed concentrations above MCLs for 1,1-DCE and PCE. Results from the "After" (after treatment) sample indicated VOC concentrations were not detected or were below MCLs. Inorganic analyses were performed on

samples collected from the Preister well during both quarters. Metals and sulfate did not exceed MCLs or alternate off-property cleanup levels.

CONCLUSIONS AND RECOMMENDATIONS

Substantial progress in aquifer restoration has been made since the cessation of interception well pumping in the mid 1990's. The limited areas of residual exceedance of cleanup criteria are intermittent defined along an axis from source area to the down gradient terminus. This terminus is controlled by three irrigation wells and monitored through sampling of monitoring wells MW92-3A and B and the Preister domestic well.

The distribution of total residual organic compounds in the aquifer occurs in two areas near wells MW89-15, MW89-12 and OIW (source area wells) and at wells MW92-3A, MW92-3B and the Preister Domestic well (down gradient wells). No significant deviations occurred during the forty-eighth and forty-ninth quarters in these residual occurrences. There is evidence of the control of the ambient flow of groundwater and capture by interceptor and irrigation wells along this axis.

With the exception of seasonal exceedances at monitoring well 89-15 which are demonstrated to attenuate below MCLs as the aquifer water flows down-gradient through the other monitoring wells, the residuum is being removed from the aquifer on a seasonal basis by the irrigation well attenuation and ultimate extraction. A proposal is being prepared to address the exceedances at MW89-15 using direct injection of a hydrogen-releasing compound to induce anaerobic digestion of the residual chlorinated organics. This technique has been used successfully at numerous sites nationally to complete aquifer restoration for chlorinated solvents faster than traditional methods. A technical proposal with citations will be provided to EPA under separate cover. MW89-12 should remain as a contingent recovery well down gradient of this proposed limited remedial action.

If you have any questions regarding this Enhanced Groundwater Remediation Progress Report, please do not hesitate to call me at your convenience.

Very truly yours,

URS CORPORATION

Roy W. Elliott
Project Coordinator

Table 1
Summary of Pumping Volumes and pH
Forty-Eighth and Forty-Ninth Quarters
October 1, 2000 through March 31, 2001
Lindsay Manufacturing Company

	TIW		AO1W		OIW		MW 89-12		Total
	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Gallons
Monthly Summary									
October-00	0	NA	0	NA	0	NA	2,653,949	NA	2,653,949
November-00	0	NA	0	7.2	0	6.5	469,132	6.5	469,132
December-00	0	NA	0	NA	0	NA	0	NA	0
January-01	0	NA	0	NA	0	NA	0	NA	0
February-01	0	NA	0	6.2	0	6.5	0	6.6	0
March-01	0	NA	0	NA	0	NA	1,309,256	NA	1,309,256
48th Quarter									
October, November, December 2000	0	NA	0	7.2	0	6.5	3,123,081	6.5	3,123,081
49th Quarter									
January, February, March 2001	0	NA	0	6.2	0	6.5	1,309,256	6.6	1,309,256
48th and 49th Quarters	0	NA	0	NA	0	NA	4,432,337	NA	4,432,337

NA Not Applicable or Not Analyzed

Table 2
Summary of Wells Sampled and Analytical Plan
Forty-Eighth and Forty-Ninth Quarterly Sampling Rounds
October 1, 2000 through March 31, 2001
Lindsay Manufacturing Company

Well ID	pH (lab) (EPA Method 150.1)	Volatile Organic Compounds (EPA Method 8260)	Total Zinc (CLP Method)	Sulfate (EPA Method 375.2)	Total Cadmium (CLP Method)	Total Chromium (CLP Method)	Total Iron (CLP Method)	Total Lead (CLP Method)
Samples Collected November 2000								
87-3	X	X	X	X	X	X	X	X
89-12		X						
89-13		X						
89-14	X	X	X	X	X	X	X	X
89-15	X	X	X	X	X	X	X	X
92-3A	X	X	X	X	X	X	X	X
92-3B	X	X	X	X	X	X	X	X
AOI Well		X						
OI Well		X						
Preister's Domestic (Before)	X	X	X	X	X	X	X	X
Preister's Domestic (After)	X	X	X	X	X	X	X	X
Samples Collected February 2001								
87-3	X	X	X	X	X	X	X	X
89-12		X						
89-13		X						
89-14	X	X	X	X	X	X	X	X
89-15	X	X	X	X	X	X	X	X
92-3A		X						
92-3B		X						
AOI Well		X						
OI Well		X						
Preister's Domestic (Before)	X	X	X	X	X	X	X	X
Preister's Domestic (After)	X	X	X	X	X	X	X	X

Table 3
Summary of Analytical Results for Inorganic Compounds
Forty-Eighth and Forty-Ninth Quarterly Sampling Rounds
October 2000 through March 2001
Lindsay Manufacturing Company

Well ID	Lab ID	Field Measurements				Total Metals (mg/L)					
		pH (field)	pH (lab)	Water Temperature (°C) (field)	Specific Conductivity (umhos/cm) (field)	Zinc	Sulfate	Cadmium	Chromium	Iron	Lead
Federal MCL		6.5-8.5*	6.5-8.5*	NS	NS	5.0*	250*	0.005	0.05	0.3*	0.05
Alternate Cleanup Level[1]- On Property		≥ 5.0	≥ 5.0	NE	NE	NE	500	NE	NE	10	NE
Alternate Cleanup Level[1]- Off Property		≥ 6.3	≥ 6.3	NE	NE	NE	400	NE	NE	1	NE
Historical Data:											
Old Lindsay Public Supply Well (Sampled January 1977)		NA	7.4	NA	NA	NA	NA	NA	NA	NA	NA
Old Lindsay Public Supply Well (Sampled 01/28/83)		NA	7.2	NA	NA	NA	NA	NA	NA	NA	NA
15261 (Sampled 01/28/83)		NA	7.0	NA	NA	0.11	3.1	U	U	NA	U
15262 (Sampled 01/28/83)		NA	7.1	NA	NA	0.11	14.0	U	U	NA	U
Samples Collected November 2000											
87-3	00-23044-CM93H	6.5	6.7 J	11.0	980	0.308	32	0.002 U	0.006	0.09	0.001 U
89-14	00-23043-CM93G	5.7	5.5 J	12.2	490	**11.6**	270	**0.005**	0.005 U	2.01	0.001 U
89-15	00-23042-CM93F	5.9	5.7 J	10.8	1440	**53.5**	750	**0.005**	0.006	**11.1**	0.001
92-3A	00-23050-CM95A	6.8	7.0 J	11.3	575	0.010	20	0.002 U	**0.091**	2.51	0.003
92-3B	00-23051-CM95B	6.6	6.9 J	11.3	906	0.006 U	250	0.002 U	0.012	0.19	0.001 U
Preister's Domestic (Before)	00-23045-CM93I	7.1	7.1 J	15.6	906	0.194	50	0.002 U	0.005 U	0.02 U	0.003
Preister's Domestic (After)	00-23046-CM93J	7.2	7.2 J	15.4	915	0.039	50	0.002 U	0.005 U	0.02 U	0.002
Samples Collected February 2001											
87-3	01-1813-CT36D	6.5	6.6 J	11.3	1040	0.169	32	0.002 U	0.007	0.09	0.001 U
89-14	01-1812-CT36C	5.7	5.4 J	11.2	744	**17.0**	320	**0.006**	0.005 U	2.18	0.001
89-15	01-1811-CT36B	6.0	5.8 J	10.2	1460	**60.0**	690	**0.005**	0.008	20.5	0.002
Preister's Domestic (Before)	01-1816-CT36G	6.8	7.1 J	11.3	987	0.135	110	0.002 U	0.005 U	0.02 U	0.003
Preister's Domestic (After)	01-1817-CT36H	7.0	7.2 J	10.9	960	0.050	110	0.002 U	0.005 U	0.02 U	0.001

Notes:
* EPA secondary MCLs
NA = Not Analyzed or Not Available
NS = No Standard
NE = Not Established
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
Bold font indicates result reported is above or equal to the MCL (zinc, cadmium, chromium, or lead) or the applicable alternate cleanup level (pH, sulfate, iron).
[1] Reference letter from State of Nebraska to Lindsay Manufacturing Company dated 12/14/00

Table 4
Summary of Analytical Results for Organic Compounds
Forty-Eighth and Forty-Ninth Quarterly Sampling Rounds
October 2000 through March 2001
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C°) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
State MCL						reserved	NS	NS	reserved	reserved	NS	reserved	-
EPA MCL						7	NS	170	5	200	5	5	-
Samples Collected November 2000													
87-3	00-23044-CM93H	6.5	6.7 J	11.0	980	15	5 U	5 U	5 U	29	5 U	5 U	44
89-12	00-23039-CM93C	6.5	NA	12.2	910	14	5 U	5 U	5 U	42	5 U	138	186
89-13	00-23040-CM93D	7.6	NA	11.2	470	5 U	5 U	5 U	5 U	5 U	5 U	7	7
89-14	00-23043-CM93G	5.7	5.5 J	12.2	490	5 U	5 U	5 U	5 U	6	5 U	5	11
89-15	00-23042-CM93F	5.9	5.7 J	10.8	1440	180	25	9	5 U	220	5 U	160	594
92-3A	00-23050-CM95A	6.8	7.0 J	11.3	575	9	5 U	5 U	5 U	110	5 U	46	165
92-3B	00-23051-CM95B	6.6	6.9 J	11.3	906	10	5 U	5 U	5 U	34	5 U	15	59
AOI Well	00-23041-CM93E	7.2	NA	11.4	440	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	00-23038-CM93B	6.5	NA	10.7	730	7	5 U	5 U	5 U	7	5 U	8	22
Preister's Domestic (Before)	00-23045-CM93I	7.1	7.1 J	15.6	906	15	5 U	5 U	5 U	33	5 U	20	68
Preister's Domestic (After)	00-23046-CM93J	7.2	7.2 J	15.4	915	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
Samples Collected February 2001													
87-3	01-1813-CT36D	6.5	6.6 J	11.3	1040	14	5 U	5 U	5 U	28	5 U	5 U	42
89-12	01-1818-CT36I	6.6	NA	11.4	846	11	5 U	5 U	5 U	31	5 U	88	130
89-13	01-1820-CT36K	7.1	NA	12.0	593	5 U	5 U	5 U	5 U	5 U	5 U	9	9
89-14	01-1812-CT36C	5.7	5.4 J	11.2	744	9	5 U	5 U	5 U	10	5 U	8	27
89-15	01-1811-CT36B	6.0	5.8 J	10.2	1460	138	14	6	5 U	180	5 U	100	430
92-3A	01-2048-CT70A	6.9	NA	11.3	574	7	5 U	5 U	5 U	130	5 U	49	186
92-3B	01-2049-CT70B	6.5	NA	11.4	795	5 U	5 U	5 U	5 U	26	5 U	12	38
AOI Well	01-1819-CT36J	6.2	NA	11.6	471	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	01-1810-CT36A	6.5	NA	11.3	749	14	5 U	5 U	5 U	5	5 U	24	43
Preister's Domestic (Before)	01-1816-CT36G	6.8	7.1 J	11.3	987	22	5 U	5 U	5 U	52	5 U	26	100
Preister's Domestic (After)	01-1817-CT36H	7.0	7.2 J	10.9	960	5 U	5 U	5 U	5 U	7	5 U	5 U	7

Notes:
NA = Not Analyzed or Not Available
ND = Not Detected
NS = No Standard
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
Bold font indicates result reported is above or equal to the MCL.

URS

October 10, 2001

Ms. Diane Easley
EPA Project Coordinator
United States Environmental Protection Agency
Superfund Division
726 Minnesota Avenue
Kansas City, Kansas 66101

Enhanced Groundwater Remediation
Progress Report
U.S. v. Lindsay Manufacturing Company
C.A. 8:92-00015
URS Job No.: 53-16657002.00

Dear Ms. Easley:

Lindsay Manufacturing Company is pleased to submit this Enhanced Groundwater Remediation Progress Report summarizing the Consent Decree items completed or undertaken during the period from April 1, 2001 to September 30, 2001. This report presents a summary of groundwater remedial pumping and analytical results from the fiftieth (May 2001) and fifty-first (August 2001) quarterly rounds of groundwater sampling.

REMEDIAL PUMPING

During the fiftieth and fifty-first quarters, monitoring well MW89-12 was the only well operated within the interceptor system. Pumping at this well was conducted from April 1 through September 30, 2001 with intermittent stops for maintenance. Monthly summaries of total gallons pumped are presented in Table 1.

GROUNDWATER MONITORING

Groundwater samples were collected in May 2001 (fiftieth quarter) and August 2001 (fifty-first quarter). A summary of wells sampled and the analytical program is presented in Table 2. Samples were analyzed for volatile organic compounds (VOCs), metals and sulfate. Field measurements for pH, temperature and specific conductivity were collected at the time of sample collection. Laboratory analytical results and field measurements are summarized in Tables 3 and 4. Copies of data validation memoranda and laboratory data pages are included in the attachment to this report. Monitoring well locations are shown on Figure 1.

Sample analytical data for VOCs, zinc, cadmium, chromium and lead were compared to federal maximum contaminant levels (MCLs) and secondary MCLs where available as described below. Sulfate, iron and pH were compared to alternate cleanup levels agreed upon by the State of Nebraska, EPA and Lindsay Manufacturing in December 2000. Analytical anomalies were not identified during the data validation process.

PERCHED SAND CHANNEL

Zinc concentrations in groundwater collected from monitoring well MW89-14 were above the federal MCL (5.0 mg/L) during the fiftieth and fifty-first quarters and ranged from 11.6 to 13.3 mg/L.

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Seattle, WA 98101-1616
Tel: 206.438.2700
Fax: 206.438.2699

Cadmium was equal to the MCL (0.005 mg/L) in the fiftieth quarter and just below the MCL in the fifty-first quarter (0.004 mg/L). Chromium and lead were either not detected or detected below MCLs during the fiftieth and fifty-first quarters. Sulfate, pH and iron were below or within the acceptable range of the newly established alternate cleanup levels for on-property wells.

Metals and sulfate were analyzed in the sample collected from well MW89-13 during the fiftieth quarter but not the fifty-first quarter. Metals and sulfate were below the MCLs and/or the alternate cleanup levels.

Tetrachloroethene (PCE) was detected above the MCL in samples collected from wells MW89-13 and MW89-14 during both the fiftieth and fifty-first quarters. 1,1-Dichloroethene (1,1-DCE) was detected above the MCL in the sample collected from well MW89-14 during the fiftieth quarter. Other VOCs were either not detected or their concentrations were below the MCLs. The concentration of total VOCs detected at wells MW89-13 and MW89-14 during the fiftieth and fifty-first quarters ranged from 5 to 26 ug/L, similar to the forty-eighth and forty-ninth quarters (7 to 27 ug/L).

SAND AND GRAVEL AQUIFER

Concentrations of zinc, cadmium, chromium and lead detected in wells completed in the sand and gravel aquifer were below MCLs with the exception of groundwater collected from wells MW89-15 and MW92-3A. Zinc in groundwater collected from well MW89-15 was above the MCL during the fiftieth and fifty-first quarters. Cadmium at MW89-15 was detected during the fifty-first quarter at a concentration of 0.010 mg/L, above the MCL (0.005 mg/L). Chromium was above the MCL in groundwater collected from well MW92-3A during the fiftieth quarter. The alternate cleanup level for on-property wells for sulfate and iron was exceeded during the fifty-first quarter in groundwater collected from MW89-15. The pH generally ranged from 6.0 to 7.0 in groundwater collected from the aquifer. However, the sample collected from monitoring well MW89-15 during the fifty-first quarter had a pH of 4.6 which is below the alternate cleanup level for on-property wells. These conditions are consistent with irrigation stress on the aquifer found to induce drainage of the aquitard at and around MW89-15 in dry summers.

1,1-DCE, 1,1,1-trichloroethane (TCA) and PCE were detected in several wells during both quarterly sampling rounds. 1,1-DCE and/or PCE were above MCLs in wells MW87-3, MW89-12, MW89-15, MW92-3A, MW92-3B and OIW during both quarterly sampling rounds.

1,1,1-TCA (450 ug/L) was detected above the MCL (200 ug/L) in the sample collected from MW89-15 in August 2001. Concentrations of 1,1,1-TCA detected in other wells were below the MCL. 1,2-Dichloroethene (1,2-DCE), was detected below the MCL during the fifty-first quarter in wells MW89-12 and MW89-15. Trichloroethene (TCE) was detected during the fifty-first quarter in wells MW89-12 and MW89-15 at concentrations from 6 to 8 ug/L, above the MCL of 5 ug/L. 1,2-Dichloroethane was not detected in any of the wells sampled during the fiftieth and fifty-first quarters. 1,1-Dichloroethane (1,1-DCA) was detected in samples from wells MW87-3, MW89-12, MW92-3A, MW89-15 and OI Well. A MCL has not been established for 1,1-DCA.

Samples were collected from the Preister Domestic wells during the fiftieth and fifty-first quarters. Results from the "Before" (pre-treatment) sample showed concentrations above MCLs for 1,1-DCE and

PCE. Results from the "After" (after treatment) sample indicated VOC concentrations were not detected or were below MCLs. Inorganic analyses were performed on samples collected from the Preister well during both quarters. Metals and sulfate did not exceed MCLs or alternate off-property cleanup levels.

CONCLUSIONS AND RECOMMENDATIONS

Substantial progress in aquifer restoration has been made since the cessation of interception well pumping in the mid 1990's. The limited areas of residual exceedance of cleanup criteria are intermittent defined along an axis from source area to the down gradient terminus. This terminus is controlled by three irrigation wells and monitored through sampling of monitoring wells MW92-3A, MW92-3B and the Preister domestic well.

The distribution of total residual organic compounds in the aquifer occurs in two areas near wells MW89-15, MW89-12 and OIW (source area wells) and at wells MW92-3A, MW92-3B and the Preister Domestic well (down gradient wells). No significant deviations occurred during the fiftieth and fifty-first quarters in these residual occurrences other than an increase in concentrations at wells MW89-15, OI Well and MW89-12 during the fifty-first quarter. Increases in the residual concentrations of VOCs in the summer sampling event are consistent with seasonal trends experienced in previous summers in which irrigation wells were operated. Control of the ambient flow of groundwater and capture by interceptor well MW89-12 and irrigation wells along this axis continues.

As discussed in previous reports, residuum in an aquitard on top of the aquifer is induced to drain into the aquifer during seasonal irrigation well operation. As a result, URS designed an insitu treatment using Hydrogen-Releasing Compound (HRC). With EPAs' approval, HRC was injected into the soils above the aquifer where residual organics persist. HRC induces anaerobic digestion of the residual chlorinated organics and enhances the remediation process. The work was performed in September 2001 per the technical proposal dated May 25, 2001 and associated addenda submitted by Lindsay Manufacturing and approved by EPA and the Nebraska Department of Environmental Quality (NDEQ) in July 2001. Per the proposal, dissolved oxygen, oxidation-reduction potential, sulfate, sulfide and dissolved iron will be added to the quarterly monitoring scheme for wells MW89-12, MW89-13, MW89-14 and MW89-15. These parameters provide a mechanism to monitor the consumption rate of HRC and the digestion of the VOCs. Monitoring for VOCs will be monthly from these four wells when irrigation resumes in the area. The additional data will be reported in subsequent groundwater remediation reports.

We recommend that MW89-12 remain operational as a recovery well down gradient of this remedial polishing. This well captures residuum and by-products of the HRC induced digestion without causing more rapid drainage to the aquifer.

If you have any questions regarding this Enhanced Groundwater Remediation Progress Report, please do not hesitate to call me at your convenience.

Very truly yours,
URS CORPORATION

Roy W. Elliott
Project Coordinator

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Table 1
Summary of Pumping Volumes and pH
Fiftieth and Fifty-First Quarters
April 1, 2001 through September 30, 2001
Lindsay Manufacturing Company

	TIW		AOIW		OIW		MW 89-12		Total
	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Gallons
Monthly Summary									
April-01	0	NA	0	NA	0	NA	1,215,407	NA	1,215,407
May-01	0	NA	0	NA	0	NA	1,905,383	6.6	1,905,383
June-01	0	NA	0	NA	0	NA	2,845,380	NA	2,845,380
July-01	0	NA	0	NA	0	NA	2,185,802	NA	2,185,802
August-01	0	NA	0	NA	0	NA	2,771,392	6.1	2,771,392
September-01	0	NA	0	NA	0	NA	1,952,343	NA	1,952,343
50th Quarter									
April, May, June	0	NA	0	NA	0	NA	5,966,170	6.6	5,966,170
51st Quarter									
July, August, September	0	NA	0	NA	0	NA	6,909,537	6.1	6,909,537
50th and 51st Quarters	0	NA	0	NA	0	NA	12,875,707	NA	12,875,707

NA Not Applicable or Not Analyzed

Table 2
Summary of Wells Sampled and Analytical Plan
Fiftieth and Fifty-First Quarterly Sampling Rounds
April through September 2001
Lindsay Manufacturing Company

Well ID	pH (lab) (EPA Method 150.1)	Volatile Organic Compounds (EPA Method 8260)	Total Zinc (CLP Method)	Sulfate (EPA Method 375.2)	Total Cadmium (CLP Method)	Total Chromium (CLP Method)	Total Iron (CLP Method)	Total Lead (CLP Method)
Samples Collected May 2001								
87-3	X	X	X	X	X	X	X	X
89-12	X	X	X	X	X	X	X	X
89-13	X	X	X	X	X	X	X	X
89-14	X	X	X	X	X	X	X	X
89-15	X	X	X	X	X	X	X	X
92-3A	X	X	X	X	X	X	X	X
92-3B	X	X	X	X	X	X	X	X
AOI Well	X	X	X	X	X	X	X	X
OI Well	X	X	X	X	X	X	X	X
Preister's Domestic (Before)	X	X	X	X	X	X	X	X
Preister's Domestic (After)	X	X	X	X	X	X	X	X
Samples Collected August 2001								
87-3	X	X	X	X	X	X	X	X
89-12		X						
89-13		X						
89-14	X	X	X	X	X	X	X	X
89-15	X	X	X	X	X	X	X	X
92-3A		X						
92-3B		X						
AOI Well		X						
OI Well		X						
Preister's Domestic (Before)	X	X	X	X	X	X	X	X
Preister's Domestic (After)	X	X	X	X	X	X	X	X

Table 3
Summary of Analytical Results for Inorganic Compounds
Fiftieth and Fifty-First Quarterly Sampling Rounds
April through September 2001
Lindsay Manufacturing Company

Well ID	Lab ID	Field Measurements				Total Metals (mg/L)					
		pH (field)	pH (lab)	Water Temperature (^{O}C) (field)	Specific Conductivity (umhos/cm) (field)	Zinc	Sulfate	Cadmium	Chromium	Iron	Lead
Federal MCL		6.5-8.5*	6.5-8.5*	NS	NS	5.0*	250*	0.005	0.05	0.3*	0.05
Alternate Cleanup Level[1]- On Property		≥ 5.0	≥ 5.0	NE	NE	NE	500	NE	NE	10	NE
Alternate Cleanup Level[1]- Off Property		≥ 6.3	≥ 6.3	NE	NE	NE	400	NE	NE	1	NE
Historical Data:											
Old Lindsay Public Supply Well (Sampled January 1977)		NA	7.4	NA	NA	NA	NA	NA	NA	NA	NA
Old Lindsay Public Supply Well (Sampled 01/28/83)		NA	7.2	NA	NA	NA	NA	NA	NA	NA	NA
15261 (Sampled 01/28/83)		NA	7.0	NA	NA	0.11	3.1	U	U	NA	U
15262 (Sampled 01/28/83)		NA	7.1	NA	NA	0.11	14.0	U	U	NA	U
Samples Collected May 2001											
87-3	01-8424-DD50G	6.25	6.58 J	10.9	930	0.145	27	0.002 U	0.007	0.06	0.001 U
89-12	01-8419-DD50B	6.40	6.62 J	12.5	864	0.999	130	0.002 U	0.005 U	0.02 U	0.001 U
89-13	01-8420-DD50C	7.20	7.44 J	11.9	550	0.219	28	0.002 U	0.005 U	0.04	0.001 U
89-14	01-8422-DD50E	5.38	5.18 J	13.5	731	13.3	310	0.005	0.009	3.29	0.002
89-15	01-8421-DD50D	6.46	6.58 J	12.2	1154	24.6	240	0.002	0.009	1.67	0.001 U
92-3A	01-8532-DD70D	6.85	6.97 J	11.9	574	0.011	20	0.002 U	0.067	1.12	0.002
92-3B	01-8533-DD70E	6.50	6.72 J	12.2	737	0.006 U	140	0.002 U	0.019	0.11	0.001 U
AOI Well	01-8425-DD50H	6.32	6.43 J	13.4	459	2.09	43	0.002	0.005 U	0.08	0.001 U
OI Well	01-8418-DD50A	6.58	6.72 J	11.5	855	3.78	160	0.002 U	0.005 U	0.23	0.001 U
Preister's Domestic (Before)	01-8426-DD50I	6.98	7.03 J	16.2	943	0.132	150	0.002 U	0.005 U	0.02 U	0.004
Preister's Domestic (After)	01-8427-DD50J	6.99	7.08 J	15.4	961	0.047	160	0.002 U	0.005 U	0.02 U	0.001 U
Samples Collected August 2001											
87-3	01-13993-DM45F	6.45	6.6 J	15.2	798	1.04	41	0.002 U	0.008	0.08	0.001 U
89-14	01-13991-DM45D	6.07	6.2 J	14.0	969	11.6	240	0.004	0.017	5.66	0.010
89-15	01-13992-DM45E	4.92	4.6 J	15.1	1,998	118	1,300	0.010	0.01	56.4	0.005 U
Preister's Domestic (Before)	01-13995-DM45H	6.93	7.0 J	19.6	816	0.027	100	0.002 U	0.005 U	0.02 U	0.001 U
Preister's Domestic (After)	01-13996-DM45I	7.01	7.0 J	18.3	823	0.009	100	0.002 U	0.005 U	0.02 U	0.001 U

Notes:
* EPA secondary MCLs
NA = Not Analyzed or Not Available
NS = No Standard
NE = Not Established
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
Bold font indicates result reported is above or equal to the MCL (zinc, cadmium, chromium, or lead) or the applicable alternate cleanup level (pH, sulfate, iron).
[1] Reference letter from State of Nebraska to Lindsay Manufacturing Company dated 12/14/00

Table 4
Summary of Analytical Results for Organic Compounds
Fiftieth and Fifty-First Quarterly Sampling Rounds
April through September 2001
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C°) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
State MCL						reserved	NS	NS	reserved	reserved	NS	reserved	-
EPA MCL		6.5-8.5*	6.5-8.5*	NS	NS	7	NS	170	5	200	5	5	-
Alternate Cleanup Level [1] - On Property		≥ 5.0	≥ 5.0	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Alternate Cleanup Level [1] - Off Property		≥ 6.3	≥ 6.3	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Samples Collected May 2001													
87-3	01-8424-DD50G	6.25	6.58 J	10.9	930	17	6	5 U	5 U	40	5 U	5 U	63
89-12	01-8419-DD50B	6.40	6.62 J	12.5	864	33	12	5 U	5 U	66	5 U	140	251
89-13	01-8420-DD50C	7.20	7.44 J	11.9	550	5 U	5 U	5 U	5 U	5 U	5 U	12	12
89-14	01-8422-DD50E	5.38	5.18 J	13.5	731	8	5 U	5 U	5 U	10	5 U	8	26
89-15	01-8421-DD50D	6.46	6.58 J	12.2	1154	59	5 U	5 U	5 U	81	5 U	43	183
92-3A	01-8532-DD70D	6.85	6.97 J	11.9	574	11	3.3	1.0 U	1.0 U	120	1.0 U	42	176
92-3B	01-8533-DD70E	6.50	6.72 J	12.2	737	4.7	1.0 U	1.0 U	1.0 U	17	1.0 U	7.7	29
AOI Well	01-8529-DD70A	6.32	6.43 J	13.4	459	1.0 U	1.0 U	1.0 U	1.0 U	1.8	1.0 U	1.0 U	1.8
OI Well	01-8418-DD50A	6.58	6.72 J	11.5	855	26	5 U	5 U	5 U	9	5 U	44	79
Preister's Domestic (Before)	01-8530-DD70B	6.98	7.03 J	16.2	943	49	5.1	2.5	1.0 U	110	1.0 U	46	213
Preister's Domestic (After)[2]	01-8531-DD70C	6.99	7.08 J	15.4	961	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Samples Collected August 2001													
87-3	01-13993-DM45F	6.45	6.6 J	15.2	798	12	5 U	5 U	5 U	21	5 U	5 U	33
89-12	01-13988-DM45A	6.06	NA	14.2	1,390	75	64	10	5 U	120	8	370	647
89-13	01-13989-DM45B	7.43	NA	12.8	578	5 U	5 U	5 U	5 U	5 U	5 U	5	5
89-14	01-13991-DM45D	6.07	6.2 J	14.0	969	6	5 U	5 U	5 U	9	5 U	7	22
89-15	01-13992-DM45E	4.92	4.6 J	15.1	1,998	280	89	73	5 U	450	6	270	1,168
92-3A	01-14258-DM85B	6.79	NA	13.9	524	5 U	5 U	5 U	5 U	75	5 U	32	107
92-3B	01-14259-DM85C	6.33	NA	13.6	681	5 U	5 U	5 U	5 U	17	5 U	9	26
AOI Well	01-14257-DM85A	6.02	NA	13.0	437	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	01-13990-DM45C	6.41	NA	15.2	1,132	66	10	5 U	5 U	100	5 U	56	232
Preister's Domestic (Before)	01-13995-DM45H	6.93	7.0 J	19.6	816	33	3.8	1.8	1 U	63	1 U	32	134
Preister's Domestic (After)[3]	01-13996-DM45I	7.01	7.0 J	18.3	823	1.8	1.9	1 U	1 U	16	1 U	1 U	20

Notes:
NA = Not Analyzed or Not Available
ND = Not Detected
NS = No Standard
*EPA Secondary MCL
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
Bold font indicates result reported is above or equal to the MCL.

[1] Reference letter from State of Nebraska to Lindsay Manufacturing Company dated 12/14/00

[2] Styrene at a concentration of 1.0 ug/L was detected in the Preister's Domestic (After) well. The result was qualified as estimated during data review. The MCL for Styrene is 100 ug/L.

[3] Styrene at a concentration of 1.0 ug/L was detected in the Preister's Domestic (After) well. The MCL for Styrene is 100 ug/L.

URS

April 10, 2002

Ms. Diane Easley
EPA Project Coordinator
United States Environmental Protection Agency
Superfund Division
726 Minnesota Avenue
Kansas City, KS 66101

Enhanced Groundwater Remediation
Progress Report
U.S. v. Lindsay Manufacturing Company
C.A. 8:92-00015
URS Job No.: 53-16657002.00

Dear Ms. Easley:

Lindsay Manufacturing Company is pleased to submit this Enhanced Groundwater Remediation Progress Report summarizing the Consent Decree items completed or undertaken during the period from October 1, 2001 to March 31, 2002. This report presents a summary of groundwater remedial pumping and analytical results from the fifty-second (November 2001) and fifty-third (February 2002) quarterly rounds of groundwater sampling. Also included in this report are the additional data collected as part of the on-going monitoring associated with the Hydrogen-Releasing Compound (HRC) remedial treatment performed in September 2001 as described in *Work Plan, Polishing Upper Aquifer Water, Lindsay Manufacturing Facility, Lindsay, Nebraska* (Work Plan) dated May 25, 2001 and associated amendments.

REMEDIAL PUMPING

During the fifty-second and fifty-third quarters, monitoring well MW89-12, retrofitted with a pump to function as an upper aquifer interceptor well, was the only well operated within the interceptor system. Pumping at this well was conducted from October 1, 2001 through November 28, 2001 when the well was shut down for the winter. Pumping resumed on March 12, 2002 and was shut down on March 21, 2002 due to equipment problems that are currently being addressed. Monthly summaries of total gallons pumped are presented in Table 1.

GROUNDWATER MONITORING

Groundwater samples were collected in November 2001 (fifty-second quarter) and February 2002 (fifty-third quarter). A summary of wells sampled and the analytical program is presented in Table 2. Samples were analyzed for volatile organic compounds (VOCs), metals and sulfate per the modified Statement of Work associated with the Consent Decree. Field measurements for pH, temperature and specific conductivity were recorded at the time of sample collection. Laboratory analytical results and field measurements are summarized in Tables 3 and 4. Additionally, as part of the on-going monitoring for the HRC remedial treatment, samples from wells MW89-12,

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MW89-13, MW89-14 and MW89-15 were analyzed for dissolved oxygen (DO), oxidation-reduction potential (ORP), sulfate, sulfide and dissolved iron. These parameters provide a mechanism to monitor the consumption of HRC. Copies of data validation memoranda and laboratory data pages are included in the attachment to this report. Monitoring well locations are shown on Figure 1.

Sample analytical data for VOCs, zinc, cadmium, chromium and lead were compared to federal maximum contaminant levels (MCLs) and secondary MCLs where available as described below. Sulfate, iron and pH were compared to alternate cleanup levels agreed upon by the State of Nebraska, EPA and Lindsay Manufacturing in December 2000. Analytical anomalies were not identified during the data validation process.

PERCHED SAND CHANNEL

Zinc concentrations in groundwater collected from monitoring well MW89-14 were above the federal MCL (5.0 mg/l) during the fifty-second and fifty-third quarters and ranged from 10.1 to 16.1 mg/l. Cadmium, chromium and lead were either not detected or detected below MCLs in samples collected from well MW89-14 during the fifty-second and fifty-third quarters. Sulfate, pH and iron were below or within the acceptable range of the alternate cleanup levels for on-property wells.

Monitoring well MW89-13 was not sampled for metals and inorganic parameters during the fifty-second and fifty-third quarterly monitoring except as specified for the HRC treatment monitoring. The results of this monitoring are described in section "MONITORING PARAMETERS FOR HRC TREATMENT" of this report.

VOCs were not detected during the fifty-second and fifty-third quarters in samples collected from well MW89-13. Tetrachloroethene (PCE) was detected equal to (5 ug/l) or just above (6 ug/l) the MCL in samples collected from well MW89-14 during the fifty-second and fifty-third quarters, respectively. 1,1,1-Trichloroethane (1,1,1-TCA) was detected below the MCL in the sample collected from well MW89-14 during the fifty-second quarter. Other VOCs were not detected at MW89-14 during the fifty-second and fifty-third quarters. The concentration of total VOCs detected at wells MW89-13 and MW89-14 during the fifty-second and fifty-third quarters were lower than the total VOCs detected during the previous two quarters.

SAND AND GRAVEL AQUIFER

Concentrations of zinc, cadmium, chromium and lead detected in wells completed in the Sand & Gravel Aquifer were below MCLs with the exception of groundwater collected from wells MW89-15, MW92-3A and MW92-3B. Zinc in groundwater collected from well MW89-15 was above the MCL during the fifty-second and fifty-third quarters. Cadmium was above the MCL in the sample collected from MW89-15 during the fifty-second quarter. Chromium was detected above the MCL during the fifty-second quarter in samples collected from wells MW92-3A and MW92-3B. The alternate cleanup level for on-property wells for sulfate and iron was exceeded during the fifty-second quarter in groundwater collected from MW89-15. The sulfate concentration at well MW89-15 also exceeded the alternate cleanup level during the fifty-third quarter. The pH generally ranged from 6.0 to 7.0 in groundwater collected from the aquifer. However, the sample collected

from monitoring well MW89-15 during the fifty-second quarter had a pH of 4.8, below the alternate cleanup level for on-property wells. This condition is consistent with the lingering effects associated with irrigation stress on the aquifer during the summer that induces drainage of the aquitard at and around MW89-15.

1,1-Dichloroethene (1,1-DCE), 1,1,1-TCA and PCE were detected in several wells during both quarterly sampling rounds. 1,1-DCE and/or PCE were above MCLs in wells MW87-3, MW89-12, MW89-15, MW92-3A, MW92-3B and OIW during both quarterly sampling rounds.

1,1,1-TCA (200 ug/L) was detected at a concentration equal to the MCL (200 ug/L) in the sample collected from MW89-15 during the fifty-second quarter. Concentrations of 1,1,1-TCA detected in other wells were below the MCL. 1,2-Dichloroethene (1,2-DCE), was detected below the MCL during the fifty-second quarter in wells MW89-12 and MW89-15. 1,1-Dichloroethane (1,1-DCA) was detected in samples from wells MW89-12 during the fifty-second quarter and MW89-15 during the fifty-second and fifty-third quarters. A MCL has not been established for 1,1-DCA. Trichloroethene (TCE) and 1,2-dichloroethane (1,2-DCA) were not detected during the fifty-second and fifty-third quarters in onsite monitoring wells completed in the Sand & Gravel Aquifer.

Samples were collected from the Preister Domestic wells during the fifty-second and fifty-third quarters. Concentrations of 1,1-DCE and PCE were above the MCLs in the "Before" (pre-treatment) samples collected during both quarters. Results from the "After" (after treatment) sample indicated VOC concentrations were not detected or were below MCLs. Inorganic analyses were performed on samples collected from the Preister well during both quarters. Metals and sulfate concentrations did not exceed MCLs or alternate off-property cleanup levels.

MONITORING PARAMETERS FOR HRC TREATMENT

DO, ORP, sulfate, sulfide and dissolved iron were measured for wells MW89-12 and MW89-15 (completed in the Sand & Gravel Aquifer) and MW89-13 and MW89-14 (completed in the Sand Channel) during the fifty-second and fifty-third quarters to monitor potential water chemistry changes resulting from the HRC treatment. The results are summarized in Table 5. Generally, the results for the fifty-second and fifty-third quarters do not indicate significant changes from the initial measurements collected in August 2001. The increases and decreases noted in DO, ORP and iron concentrations may be attributable to typical seasonal fluctuations in the Sand Channel and the Sand & Gravel Aquifer. The data indicate that sulfate has not been reduced to sulfides. Based on the monitoring during the fifty-second and fifty-third quarters, there does not appear to be a measurable change in the aerobic/anaerobic conditions in the Sand Channel or the aquifer to date. The HRC injection was performed at the end of the irrigation season to allow a longer residence time in the soils beneath the Sand Channel. These soils are considered the primary residual source of chlorinated solvents at the site. Measurable changes in water chemistry are not anticipated until the irrigation season resumes inducing the drainage of groundwater and HRC from the Sand Channel through the aquitard into the Sand & Gravel Aquifer.

CONCLUSIONS AND RECOMMENDATIONS

Substantial progress in aquifer restoration has been made since the cessation of interception well pumping in the mid 1990's. The limited areas of residual exceedance of cleanup criteria are intermittent defined along an axis from source area to the down gradient terminus. This terminus is controlled by three irrigation wells and monitored through sampling of monitoring wells MW92-3A, MW92-3B and the Preister domestic well.

The distribution of total residual organic compounds in the aquifer occurs in two areas near wells MW89-15, MW89-12 and OIW (source area wells) and at wells MW92-3A, MW92-3B and the Preister Domestic well (down gradient wells). No significant deviations occurred during the fifty-second and fifty-third quarters in these residual occurrences other than decreases in concentrations at wells MW89-15, OI Well and MW89-12 as compared to the fifty-first quarter. With the cessation of irrigation well pumping for the winter, decreases in the residual concentrations of VOCs is expected based on historical trends at the site. Control of the ambient flow of groundwater and capture by interceptor well MW89-12 and irrigation wells along this axis continues.

As discussed in previous reports, insitu treatment using HRC injected into the soils above the aquifer where residual organics persist was initiated in September 2001. This action is intended to "polish" the residual VOCs in these soils. DO, ORP, sulfate, sulfide and dissolved iron were monitored during the quarterly sampling at wells MW89-12, MW89-13, MW89-14 and MW89-15. These parameters provide a mechanism to monitor the consumption rate of HRC. The data indicate that measurable changes from aerobic to anaerobic conditions have not occurred to date in the Sand Channel or Sand & Gravel Aquifer. The HRC injection was performed at the end of the irrigation season to allow a longer residence time in the soils beneath the Sand Channel. Measurable changes in water chemistry are not anticipated until the irrigation season resumes inducing the downward movement of groundwater with HRC from the Sand Channel and aquitard into the Sand & Gravel Aquifer. Monitoring will continue through the next two quarterly groundwater sampling rounds. Monthly monitoring of VOCs at monitoring well MW89-12 was started in March 2002 per the Work Plan. These data will be included in the October 2002 biannual report.

We recommend that MW89-12 remain operational as an interceptor well down gradient of this remedial polishing. This well captures residuum and by-products of the HRC induced digestion without causing more rapid drainage to the aquifer.

If you have any questions regarding this Enhanced Groundwater Remediation Progress Report, please do not hesitate to call me at your convenience.

Very truly yours,
URS CORPORATION

Roy W. Elliott
Vice President

Table 1
Summary of Pumping Volumes and pH
Fifty-Second and Fifty-Third Quarters
October 1, 2001 through March 31, 2002
Lindsay Manufacturing Company

	TIW		AOIW		OIW		MW 89-12		Total
	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Gallons
Monthly Summary									
October-01	0	NA	0	NA	0	NA	2,563,419	NA	2,563,419
November-01	0	NA	0	NA	0	NA	2,262,332	6.47	2,262,332
December-01	0	NA	0	NA	0	NA	0	NA	0
January-02	0	NA	0	NA	0	NA	0	NA	0
February-02	0	NA	0	NA	0	NA	0	6.43	0
March-02	0	NA	0	NA	0	NA	723,166	NA	723,166
52nd Quarter									
October, November, December 2001	0	NA	0	NA	0	NA	4,825,751	6.47	4,825,751
53rd Quarter									
January, February, March 2002	0	NA	0	NA	0	NA	723,166	6.43	723,166
52nd and 53rd Quarters	0	NA	0	NA	0	NA	5,548,917	NA	5,548,917

NA Not Applicable or Not Analyzed

Table 2
Summary of Wells Sampled and Analytical Plan
Fifty-Second and Fifty-Third Quarterly Sampling Rounds
October 2001 through March 2002
Lindsay Manufacturing Company

Well ID	pH (lab) (EPA Method 150.1)	Volatile Organic Compounds (EPA Method 8260)	Total Zinc (CLP Method)	Sulfate (EPA Method 375.2)	Total Cadmium (CLP Method)	Total Chromium (CLP Method)	Total Iron (CLP Method)	Total Lead (CLP Method)
Samples Collected November 2001								
87-3	X	X	X	X	X	X	X	X
89-12		X						
89-13		X						
89-14	X	X	X	X	X	X	X	X
89-15	X	X	X	X	X	X	X	X
92-3A	X	X	X	X	X	X	X	X
92-3B	X	X	X	X	X	X	X	X
AOI Well		X						
OI Well		X						
Preister's Domestic (Before)	X	X	X	X	X	X	X	X
Preister's Domestic (After)	X	X	X	X	X	X	X	X
Samples Collected February 2002								
87-3	X	X	X	X	X	X	X	X
89-12		X						
89-13		X						
89-14	X	X	X	X	X	X	X	X
89-15	X	X	X	X	X	X	X	X
92-3A		X						
92-3B		X						
AOI Well		X						
OI Well		X						
Preister's Domestic (Before)	X	X	X	X	X	X	X	X
Preister's Domestic (After)	X	X	X	X	X	X	X	X

Table 3
Summary of Analytical Results for Inorganic Compounds
Fifty-Second and Fifty-Third Quarterly Sampling Rounds
November 2001 and February 2002
Lindsay Manufacturing Company

Well ID	Lab ID	Field Measurements				Total Metals (mg/L)					
		pH (field)	pH (lab)	Water Temperature (°C) (field)	Specific Conductivity (umhos/cm) (field)	Zinc	Sulfate	Cadmium	Chromium	Iron	Lead
Federal MCL		6.5-8.5*	6.5-8.5*	NS	NS	5.0*	250*	0.005	0.05	0.3*	0.05
Alternate Cleanup Level[1]- On Property		≥ 5.0	≥ 5.0	NE	NE	NE	500	NE	NE	10	NE
Alternate Cleanup Level[1]- Off Property		≥ 6.3	≥ 6.3	NE	NE	NE	400	NE	NE	1	NE
Historical Data:											
Old Lindsay Public Supply Well (Sampled January 1977)		NA	7.4	NA	NA	NA	NA	NA	NA	NA	NA
Old Lindsay Public Supply Well (Sampled 01/28/83)		NA	7.2	NA	NA	NA	NA	NA	NA	NA	NA
15261 (Sampled 01/28/83)		NA	7.0	NA	NA	0.11	3.1	U	U	NA	U
15262 (Sampled 01/28/83)		NA	7.1	NA	NA	0.11	14.0	U	U	NA	U
Samples Collected November 2001											
87-3	01-19700-DU60D	6.35	6.6 J	11.5	949	0.219	34	0.002 U	0.009	0.08	0.001 U
89-14	01-19697-DU60A	5.88	6.3 J	11.6	660	**10.1**	170	0.003	0.027	3.31	0.005
89-15	01-19698-DU60B	5.02	**4.8 J**	12.6	2010	**127**	**1100**	**0.007**	0.01 U	**33.3**	0.001 U
92-3A	01-19786-DU75A	6.75	6.9 J	11.7	569	0.030	26	0.002 U	**0.102**	3.63	0.002
92-3B	01-19787-DU75B	6.41	6.5 J	12.2	724	0.006 U	170	0.002 U	**0.087**	1.68	0.001 U
Preister's Domestic (Before)	01-19701-DU60E	6.84	7.0 J	16.1	949	0.046	130	0.002 U	0.005 U	0.05 U	0.001 U
Preister's Domestic (After)	01-19702-DU60F	6.98	7.1 J	16.5	951	0.019	130	0.002 U	0.005 U	0.05 U	0.001 U
Samples Collected February 2002											
87-3	02-1446-EB74D	6.60	6.7 J	12.2	766	0.136	25	0.002 U	0.012	0.11	0.001 U
89-14	02-1443-EB74A	5.82	5.8 J	10.5	690	**16.1**	360	0.004	0.019	2.42	0.003
89-15	02-1444-EB74B	6.18	6.2 J	10.5	1430	**71.5**	**600**	0.002	0.008	1.84	0.001 U
Preister's Domestic (Before)	02-1502-EB89A	6.63	7.0 J	9.0	981	0.009	120	0.002 U	0.005 U	0.05 U	0.001
Preister's Domestic (After)	02-1503-EB89B	6.80	7.1 J	10.1	970	0.008	140	0.002 U	0.005 U	0.05 U	0.001 U

Notes:
* EPA secondary MCLs
NA = Not Analyzed or Not Available
NS = No Standard
NE = Not Established
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
Bold font indicates result reported is above or equal to the MCL (zinc, cadmium, chromium, or lead) or the applicable alternate cleanup level (pH, sulfate, iron).
[1] Reference letter from State of Nebraska to Lindsay Manufacturing Company dated 12/14/00

Table 4
Summary of Analytical Results for Organic Compounds
Fifty-Second and Fifty-Third Quarterly Sampling Rounds
November 2001 and February 2002
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C°) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
State MCL						reserved	NS	NS	reserved	reserved	NS	reserved	-
EPA MCL		6.5-8.5*	6.5-8.5*	NS	NS	7	NS	170	5	200	5	5	-
Alternate Cleanup Level [1] - On Property		≥ 5.0	≥ 5.0	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Alternate Cleanup Level [1] - Off Property		≥ 6.3	≥ 6.3	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Samples Collected November 2001													
87-3	01-19700-DU60D	6.35	6.6 J	11.5	949	19	5 U	5 U	5 U	30	5 U	5	54
89-12	01-19704-DU60H	6.47	NA	13.1	920	54	29	6	5 U	120	5 U	170	379
89-13	01-19705-DU60I	6.88	NA	11.3	456	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
89-14	01-19697-DU60A	5.88	6.3 J	11.6	660	5 U	5 U	5 U	5 U	8	5 U	5	13
89-15	01-19698-DU60B	5.02	4.8 J	12.6	2010	140	20	13	5 U	200	5 U	110	483
92-3A	01-19786-DU75A	6.75	6.9 J	11.7	569	12	5 U	5 U	5 U	100	5 U	42	154
92-3B	01-19787-DU75B	6.41	6.5 J	12.2	724	5 U	5 U	5 U	5 U	16	5 U	8	24
AOI Well	01-19706-DU60J	6.27	NA	13.9	463	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	01-19699-DU60C	6.44	NA	12.1	929	28	5 U	5 U	5 U	35	5 U	23	86
Preister's Domestic (Before)	01-19701-DU60E	6.84	7.0 J	16.1	949	38 J	4.7	2.2	0.3 J	77 J	0.5	37 J	159
Preister's Domestic (After)	01-19702-DU60F	6.98	7.1 J	16.5	951	1.2	1.0	0.2 U	0.2 U	5.8	0.2 U	0.2 U	8
Samples Collected February 2002													
87-3	02-1446-EB74D	6.60	6.7 J	12.2	766	22	5 U	5 U	5 U	30	5 U	6	58
89-12	02-1450-EB74H	6.43	NA	11.0	974	24	5 U	5 U	5 U	23	5 U	70	117
89-13	02-1451-EB74I	7.22	NA	9.7	528	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
89-14	02-1443-EB74A	5.82	5.8 J	10.5	690	5 U	5 U	5 U	5 U	5 U	5 U	6	6
89-15	02-1444-EB74B	6.18	6.2 J	10.5	1430	110	7	5 U	5 U	130	5 U	93	340
92-3A	02-1504-EB89C	6.79	NA	10.6	568	16	5 U	5 U	5 U	110	5 U	48	174
92-3B	02-1505-EB89D	6.45	NA	11.6	670	5 U	5 U	5 U	5 U	10	5 U	6	16
AOI Well	02-1448-EB74F	6.28	NA	13.5	379	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	02-1445-EB74C	6.73	NA	11.3	642	20	5 U	5 U	5 U	9	5 U	32	61
Preister's Domestic (Before)	02-1502-EB89A	6.63	7.0 J	9.0	981	51	5.2	2.4	1.0 U	94	1.0 U	49	202
Preister's Domestic (After)	02-1503-EB89B	6.80	7.1 J	10.1	970	1.1	0.6	0.2 U	0.2 U	3.6	0.2 U	0.2 U	5.3

Notes:
NA = Not Analyzed or Not Available
ND = Not Detected
NS = No Standard
*EPA Secondary MCL
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
Bold font indicates result reported is above or equal to the MCL.
[1] Reference letter from State of Nebraska to Lindsay Manufacturing Company dated 12/14/00

Table 5
Summary of Analytical Results for HRC Injection Monitoring Parameters
August 2001 through February 2002
Lindsay Manufacturing Company

Well ID	Field Measurements						Laboratory Analyses							
	pH (field)	pH (lab)	Water Temperature (°C) (field)	Specific Conductivity (umhos/cm) (field)	Dissolved Oxygen (mg/l)	Oxidation/Reduction Potential (mv)	Sulfate (mg/l)	Sulfide (mg/l)	Dissolved Iron (mg/l)	Total Iron (mg/l)	Nitrate as N (mg/l)	Nitrite as N (mg/l)	Orthophosphate as P (mg/l)	Aerobic Plate Count (cfu/ml)
Samples Collected August 2001 (Information to complete design)														
89-12	6.06	NA	14.2	1,390	NA	NA	354	NA	NA	NA	13.3	0.02 UJ	0.34	90
89-13	7.43	NA	12.8	578	NA	NA	32	NA	NA	NA	4.7	0.02 UJ	0.34	< 1
89-14	6.07	6.2 J	14.0	969	9.59	128	358/240 *	NA	NA	5.66	4.4	0.05 J	0.05 U	5,700
89-15	4.92	4.6 J	15.1	1,998	8.73	207	1173/1200 *	NA	NA	56.4	12.7	0.03 J	0.05 U	< 1
Samples Collected November 2001														
89-12	6.47	NA	13.1	920	10.1	262	253	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-13	6.88	NA	11.3	456	10.5	242	34	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-14	5.88	6.3 J	11.6	660	13.8	164	170	1.0 U	0.61	3.31	NA	NA	NA	NA
89-15	5.02	4.8 J	12.6	2,010	4.05	181	1100	1.0 U	38.8	33.3	NA	NA	NA	NA
Samples Collected February 2002														
89-12	6.43	NA	11.0	974	NA	225	170	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-13	7.22	NA	9.7	528	11	108	37	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-14	5.82	5.8 J	10.5	690	9.89	172	360	1.0 U	0.01 U	2.42	NA	NA	NA	NA
89-15	6.18	6.2 J	10.5	1,430	6.93	137	600	1.0 U	0.01 U	1.84	NA	NA	NA	NA

Notes:
NA = Not Analyzed or Not Available
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
* Samples were submitted for this test to Midwest Laboratories, Inc. in Omaha, NB and Analytical Resources, Inc. in Seattle, WA

URS

October 14, 2002

Ms. Diane Easley
EPA Project Coordinator
United States Environmental Protection Agency
Superfund Division
726 Minnesota Avenue
Kansas City, KS 66101

Enhanced Groundwater Remediation
Progress Report
U.S. v. Lindsay Manufacturing Company
C.A. 8:92-00015
URS Job No.: 33750799

Dear Ms. Easley:

Lindsay Manufacturing Company is pleased to submit this Enhanced Groundwater Remediation Progress Report summarizing the Consent Decree items completed or undertaken during the period from April 1, 2002 to September 30, 2002. This report presents a summary of groundwater remedial pumping and analytical results from the fifty-fourth (May 2002) and fifty-fifth (August 2002) quarterly rounds of groundwater sampling. Also included in this report are the additional data collected as part of the on-going monitoring associated with the Hydrogen-Releasing Compound (HRC) remedial treatment performed in September 2001 as described in *Work Plan, Polishing Upper Aquifer Water, Lindsay Manufacturing Facility, Lindsay, Nebraska* (Work Plan) dated May 25, 2001 and associated amendments.

REMEDIAL PUMPING

During the fifty-fourth and fifty-fifth quarters, converted monitoring well MW89-12 was the only well operated within the interceptor system. Generally, pumping at this well is started at the beginning of the irrigation season; however, the pump was shut down in late March 2002 due to equipment problems. After the pump was repaired, pumping was started and stopped on April 22, 2002. Cells #1 and #2 were cleaned out during this period and not available for storage of the water pumped from MW89-12. Lindsay requested approval from EPA and the Nebraska Department of Environmental Quality (NDEQ) to beneficially use the water from MW89-12 for irrigation purposes. Approval for application of water from MW89-12 to Lindsay owned property north of the facility was obtained from NDEQ on June 10, 2002 and pumping at MW89-12 resumed on June 20, 2002. Pumping continued through September 30, 2002 with short-term disruptions due to equipment adjustments or maintenance. Monthly summaries of total gallons pumped are presented in Table 1. No attempts were made to track the operation of downgradient irrigation wells; however, this years' drought resulted in heavy irrigation withdrawal in the vicinity.

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GROUNDWATER MONITORING

Groundwater samples were collected in May 2002 (fifty-fourth quarter) and August 2002 (fifty-fifth quarter). Additional samples were collected in June 2002 and September 2002 as noted in the summary of wells sampled and the analytical program presented in Table 2. Sample locations are shown on Figure 1. Samples were analyzed for volatile organic compounds (VOCs), metals and sulfate in accordance with the modified Statement of Work (SOW) associated with the Consent Decree. Field measurements for pH, temperature and specific conductivity were recorded at the time of sample collection. Laboratory analytical results and field measurements are summarized in Tables 3 and 4. Additionally, as part of the on-going monitoring for the HRC remedial treatment, samples from wells MW89-12, MW89-13, MW89-14 and MW89-15 were analyzed for dissolved oxygen (DO), oxidation-reduction potential (ORP), sulfate, sulfide and dissolved iron. These parameters provide a mechanism to monitor the consumption of HRC and are summarized in Table 5.

Copies of data validation memoranda and laboratory data pages are included in Appendix A of this report. Analytical anomalies were not identified during the data validation process with one exception. Due to delayed delivery to the laboratory after shipment from the site, the cooler temperatures for samples collected in May 2002, June 2002 and August 2002 exceeded the EPA standard protocol of 2 to 6 degrees C. The ambient cooler temperatures ranged from 9 degrees C to 19 degrees C. Samples were properly preserved with hydrochloric acid at pH<2 and headspace was not noted in the individual containers. Sample data associated with cooler temperatures above 15 degrees C were qualified as estimated based on the elevated temperatures at the time of laboratory receipt.

Sample analytical data for VOCs, zinc, cadmium, chromium and lead were compared to maximum groundwater contamination and established cleanup levels identified in the SOW associated with the Consent Decree. These cleanup levels primarily consists of federal maximum contaminant levels (MCLs) and secondary MCLs as described below. Sulfate, iron and pH were compared to alternate cleanup levels agreed upon by the State of Nebraska, EPA and Lindsay Manufacturing in December 2000.

PERCHED SAND CHANNEL

Zinc concentrations in groundwater collected from monitoring well MW89-14 were above the federal MCL (5.0 mg/l) during the fifty-fourth and fifty-fifth quarters and ranged from 10.5 to 17.6 mg/l, similar to the previous two quarters. Cadmium was detected just above the MCL (0.005 mg/l) during the fifty-fourth quarter at a concentration of 0.006 mg/l. The concentration of cadmium detected in the fifty-fifth quarter was just below the MCL. Chromium and lead were either not detected or detected below MCLs in samples collected from well MW89-14 during the fifty-fourth and fifty-fifth quarters. Sulfate, pH and iron were below or within the acceptable range of the alternate cleanup levels for on-property wells.

Monitoring well MW89-13 was not sampled for metals and inorganic parameters during the fifty-fourth and fifty-fifth quarterly monitoring except as specified for the HRC treatment monitoring. The results of this monitoring are described in section "MONITORING PARAMETERS FOR HRC TREATMENT" of this report.

VOCs were not detected during the fifty-fourth and fifty-fifth quarters in samples collected from well MW89-13. Tetrachloroethene (PCE) was detected above the MCL (5 ug/l) in samples collected from well MW89-14 during the fifty-fourth and fifty-fifth quarters and ranged in concentration from 7 ug/l to 9 ug/l. 1,1-Dichloroethene (1,1-DCE) was detected above the MCL (7 ug/l) in the sample collected during the fifty-fifth quarter at a concentration of 12 ug/l. 1,1,-DCE was not detected during the fifty-fourth quarter. 1,1,1-Trichloroethane (1,1,1-TCA) was detected below the MCL in samples collected from well MW89-14 during the fifty-fourth and fifty-fifth quarters. Other VOCs were not detected at MW89-14 during this monitoring period. VOCs were not detected at well MW89-13 during the current monitoring period. The concentration of total VOCs detected at well MW89-14 during the fifty-fourth quarter was similar to previous quarters. Concentrations during the fifty-fifth quarter increased from previous quarters since August 2001 (26 ug/l to 40 ug/l).

SAND AND GRAVEL AQUIFER

Concentrations of zinc, cadmium, chromium and lead detected in wells completed in the Sand & Gravel Aquifer were below MCLs with the exception of groundwater collected from wells MW89-15, OIW, MW92-3A and MW92-3B. Zinc in groundwater collected from well MW89-15 during the fifty-fourth and fifty-fifth quarters and in groundwater collected from the OIW in the fifty-fourth quarter was above the MCL. Cadmium was above the MCL in the sample collected from MW89-15 during the fifty-fifth quarter. Chromium was detected above the MCL during the fifty-fourth quarter in samples collected from wells MW92-3A and MW92-3B.

The alternate cleanup level for on-property wells for sulfate and iron was exceeded during the fifty-fifth quarter in groundwater collected from MW89-15. The alternate cleanup level for off-property wells for iron was exceeded during the fifty-fourth quarter in groundwater collected from MW92-3A. The pH generally ranged from 6.0 to 7.0 in groundwater collected from the aquifer. However, the samples collected from monitoring wells MW89-15 and MW92-3B during the fifty-fifth quarter had pH measurements of 5.3 and 5.8, respectively. These measurements are within the limitations of the alternate cleanup level for on-property wells (MW89-15) and just below the alternate cleanup level for off-property wells (MW92-3B).

1,1-DCE, 1,1,1-TCA and PCE were detected in several wells during both quarterly sampling rounds. 1,1-DCE and/or PCE were above MCLs in wells MW87-3, MW89-12, MW89-15, MW92-3A, and OIW during both quarterly sampling rounds. Only PCE was above the MCL in groundwater collected from MW92-3B during the fifty-fourth quarter. There were no MCL exceedances at MW92-3B during the fifty-fifth quarter. 1,1,1-TCA was detected above the MCL during the fifty-fifth quarter at wells MW89-15 and the OIW. 1,1,1-TCA was not detected or below the MCL in the remainder of the quarterly samples.

1,2-Dichloroethene (1,2-DCE), was detected below the MCL during the fifty-fifth quarter in wells MW89-15 and the OIW. 1,1-Dichloroethane (1,1-DCA) was detected in samples from wells MW89-12, MW89-15 and the OIW during the fifty-fifth quarter. A MCL has not been established for 1,1-DCA. Trichloroethene (TCE) and 1,2-dichloroethane (1,2-DCA) were not detected during the fifty-fourth and fifty-fifth quarters in onsite monitoring wells or downgradient wells 92-3A and 92-3B completed in the Sand & Gravel Aquifer.

Samples were collected from the Preister Domestic well during the fifty-fourth and fifty-fifth quarters. Concentrations of 1,1-DCE and PCE were above the MCLs in the "Before" (pre-treatment) samples collected during both quarters. Results from the "After" (after treatment) sample indicated VOC concentrations were not detected or were below MCLs during the fifty-fourth quarter. The after treatment sample collected during the fifty-fifth quarter indicated that 1,1-DCE exceeded the MCL. A corrective action was implemented in September 2002 and the domestic well was sampled before and after the treatment system. The data indicated that 1,1-DCE was above the MCL in the post treatment sample. Additional corrective actions to reduce the chemical concentrations in the treated water are ongoing, and the results will be reported in the next semi-annual report scheduled for April 2003 submittal. Inorganic analyses were also performed on samples collected from the Preister well ("Before" and "After") during both quarters. Metals and sulfate concentrations did not exceed MCLs or alternate off-property cleanup levels.

MONITORING PARAMETERS FOR HRC TREATMENT

DO, ORP, sulfate, sulfide and dissolved iron were measured for wells MW89-12 and MW89-15 (completed in the Sand & Gravel Aquifer) and MW89-13 and MW89-14 (completed in the Sand Channel) during the fifty-fourth and fifty-fifth quarters to monitor potential water chemistry changes resulting from the HRC treatment. The results are summarized in Table 5. Generally, the results for the fifty-fourth and fifty-fifth quarters do not indicate significant changes from the initial measurements collected in August 2001 with one exception. The one change noted is the decrease in DO measurements at MW89-12 in May 2002 and August 2002 from the original measurement of DO measured in November 2001 soon after the HRC treatment. The increases and decreases noted in DO, ORP and iron concentrations in the other wells might be attributable to typical seasonal fluctuations in the Sand Channel and the upper Sand & Gravel Aquifer. The data do not indicate that sulfate has as yet reduced to sulfides in the groundwater. Measurements were not collected in the treated soils between the Sand Channel and the aquifer.

Based on the monitoring performed during the fifty-fourth and fifty-fifth quarters, with the exception of MW89-12, there does not appear to be a measurable change in the aerobic/anaerobic conditions in the Sand Channel or the aquifer. The HRC injection was performed at the end of the irrigation season in 2001 to allow a longer residence time of the HRC in the soils beneath the Sand Channel. These soils are considered the primary residual source of chlorinated solvents at the site. Measurable changes in groundwater chemistry were not anticipated until the irrigation season resumed inducing the drainage of groundwater and HRC from the Sand Channel through the aquitard into the Sand & Gravel Aquifer. The volume of water removed from the aquifer during the 2002 irrigation season has likely resulted in a significant amount of drainage of groundwater from the Sand Channel through the aquitard. Although the data to date do not clearly indicate a definitive change due to the HRC treatment, the stress on the aquifer during the 2002 irrigation season, has likely resulted in the downward migration of HRC through the aquitard as planned. The stress on the aquifer each irrigation season typically results in increased concentrations of organics measured at MW89-15 and MW89-12. Effects of the HRC treatment may be more apparent after the November 2002 data.

ADDITIONAL FINDINGS

The Beller Domestic Well (after treatment) and Beller Stock well were sampled in September 2002 for VOCs. VOCs were not detected above the MCL in the Beller Domestic Well (after treatment). 1,1-DCE and PCE were detected above the MCL in the Beller Stock well. Other VOCs were either not detected or below MCLs.

The data collected from the Beller Stock well indicates that VOCs are currently present in the groundwater sampled at this location. Monitoring of the Beller Domestic and Stock wells was discontinued in 1999 as several years of previous data had indicated that VOCs were not present or present in very small concentrations (Appendix B).

Peaks in concentrations at on-site wells MW89-12 and MW89-15 coincide with seasonal stress on the aquifer during the summer irrigation season (Figure 2). The August 2002 concentrations decreased at both locations compared to the peak concentration in August 2001. The concentrations of VOCs in the lower Sand & Gravel Aquifer continue to show an overall decrease in the aquifer as illustrated on Figure 2 at well MW92-3B (downgradient of site). The concentrations in the upper aquifer downgradient of the site represented by MW92-3A appear to be stable with no peaks in concentration evident in the monitoring conducted since 1999. The concentrations of VOCs at the Preister well were at their highest in the period May 2000 to July 2000. Concentrations have increased and decreased based on seasonal fluctuations since then. The August 2002 results at the Preister Domestic well are slightly below the August 2001 concentrations.

The concentrations of VOCs decrease from the residual source area (represented by MW89-15) to the Preister Domestic well (Figure 2). The highest concentrations detected at most of the on-property wells occurs in August, at the end of the irrigation season. However, at the downgradient wells, the lowest concentrations from November 2001 to August 2002 were detected in August.

CONCLUSIONS AND RECOMMENDATIONS

Substantial progress in aquifer restoration has been made since the cessation of interception well pumping in the mid 1990's. The limited areas of residual exceedance of cleanup criteria are intermittent defined along an axis from source area to the down gradient terminus. This terminus is controlled by three irrigation wells and monitored through sampling of monitoring wells MW92-3A, MW92-3B and the Preister domestic well.

The distribution of total residual organic compounds in the aquifer occurs in two areas near wells MW89-15, MW89-12 and OTW (source area wells) and at wells MW92-3A, MW92-3B and the Preister Domestic well (down gradient wells). No deviations from historical trends occurred during the fifty-fourth and fifty-fifth quarters in these residual occurrences other than increases at MW89-15, MW89-12 and the OTW compared to the fifty-third quarter and a decrease in concentration at the Preister Domestic well. Increases are typical at the on-property wells in August and are the result of drainage of groundwater from the soils into the upper Sand & Gravel Aquifer. With the cessation of irrigation well pumping for the winter, decreases in the residual concentrations of VOCs is expected based on historical trends at the site. The additional data obtained from the Beller Stock well indicates that some lateral dispersion of the residuum is occurring. Control of the ambient flow of groundwater and capture by interceptor well MW89-12 and irrigation wells along

this axis continues as shown by the decreasing concentrations noted at the Priester Domestic well and stabilization at wells MW92-3A and MW92-3B.

As discussed in previous reports, insitu treatment using HRC injected into the soils above the aquifer where residual organics persist was initiated in September 2001. This action is intended to "polish" the residual VOCs in these soils. DO, ORP, sulfate, sulfide and dissolved iron were monitored during the quarterly sampling at wells MW89-12, MW89-13, MW89-14 and MW89-15. Well MW89-12 is the downgradient monitoring point for the HRC treatment. These parameters provide a mechanism to monitor the consumption rate of HRC. The data indicate that measurable changes from aerobic to anaerobic conditions occurred at well MW89-12. The HRC injection was performed at the end of the 2001 irrigation season to allow a longer residence time of HRC in the soils beneath the Sand Channel. Measurable changes in water chemistry were not anticipated until the irrigation season resumed inducing the downward movement of groundwater with HRC from the Sand Channel and aquitard into the Sand & Gravel Aquifer. The irrigation well withdrawal volume during the 2002 drought should result in a more rapid drainage of HRC than may have been expected based on previous years. The November 2002 quarterly analytical data may provide information on the results of the HRC treatment.

Based on the quarterly data collected and the additional findings, URS recommends the following for the monitoring period from October 2002 to March 2003:

- Continue pumping of modified MW89-12 as an interceptor well
- Sample the Beller Stock well and Beller Domestic (Before and After treatment) well during the next two quarters (fifty-sixth and fifty-seventh) to determine if the VOC occurrences persists.

If you have any questions regarding this Enhanced Groundwater Remediation Progress Report, please do not hesitate to contact URS at your convenience.

Very truly yours,
URS CORPORATION

Karen L. Mixon
Task Manager

Roy W. Elliott
Vice President

Table 1
Summary of Pumping Volumes and pH
Fifty-Fourth and Fifty-Fifth Quarters
April 1, 2002 through September 30, 2002
Lindsay Manufacturing Company

	TIW		AOIW		OIW		MW 89-12		Total
	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Gallons
Monthly Summary									
April-02	0	NA	0	NA	0	NA	5,822	NA	5,822
May-02	0	NA	0	NA	0	NA	0	6.67	0
June-02	0	NA	0	NA	0	NA	2,043	6.83	2,043
July-02	0	NA	0	NA	0	NA	126,252	NA	126,252
August-02	0	NA	0	NA	0	NA	1,369,607	6.25	1,369,607
September-02	0	NA	0	NA	0	NA	1,091,617	NA	1,091,617
54th Quarter									
April, May, June 2002	0	NA	0	NA	0	NA	7,865	6.67	7,865
55th Quarter									
July, August, September 2002	0	NA	0	NA	0	NA	2,587,476	6.25	2,587,476
54th and 55th Quarters	0	NA	0	NA	0	NA	2,595,341	NA	2,595,341

NA Not Applicable or Not Analyzed

Table 2
Summary of Wells Sampled and Analytical Plan
Fifty-Fourth and Fifty-Fifth Quarters
April 2002 through September 2002
Lindsay Manufacturing Company

Well ID	pH (lab) (EPA Method 150.1)	Volatile Organic Compounds (EPA Method 8260)	Total Zinc (CLP Method)	Sulfate (EPA Method 375.2)	Total Cadmium (CLP Method)	Total Chromium (CLP Method)	Total Iron (CLP Method)	Total Lead (CLP Method)
Samples Collected May 2002								
87-3	X	X	X	X	X	X	X	X
89-12		X						
89-13		X						
89-14	X	X	X	X	X	X	X	X
89-15	X	X	X	X	X	X	X	X
92-3A	X	X	X	X	X	X	X	X
92-3B	X	X	X	X	X	X	X	X
AOI Well	X	X	X	X	X	X	X	X
OI Well	X	X	X	X	X	X	X	X
Preister's Domestic (Before)	X	X	X	X	X	X	X	X
Preister's Domestic (After)	X	X	X	X	X	X	X	X
Samples Collected June 2002								
89-12		X						
Samples Collected August 2002								
87-3	X	X	X	X	X	X	X	X
89-12		X	X	X			X	
89-13		X		X				
89-14	X	X	X	X	X	X	X	X
89-15	X	X	X	X	X	X	X	X
92-3A		X						
92-3B		X						
AOI Well		X						
OI Well		X						
Preister's Domestic (Before)	X	X	X	X	X	X	X	X
Preister's Domestic (After)	X	X	X	X	X	X	X	X
Samples Collected September 2002								
Preister's Domestic (Before)		X						
Preister's Domestic (After)		X						
Beller Domestic (After)		X						
Beller Stock Well		X						

Table 3
Summary of Analytical Results for Inorganic Compounds
Fifty-Second through Fifty-Fifth Quarters
November 2001 through September 2002
Lindsay Manufacturing Company

Well ID	Lab ID	Field Measurements				Total Metals (mg/L)					
		pH (field)	pH (lab)	Water Temperature (°C) (field)	Specific Conductivity (umhos/cm) (field)	Zinc	Sulfate	Cadmium	Chromium	Iron	Lead
Federal MCL				NS	NS	5.0*		0.005	0.05		0.05
Alternate Cleanup Level[1]- On Property		≥ 5.0	≥ 5.0	NE	NE	NE	500	NE	NE	10	NE
Alternate Cleanup Level[1]- Off Property		≥ 6.3	≥ 6.3	NE	NE	NE	400	NE	NE	1	NE
Historical Data:											
Old Lindsay Public Supply Well (Sampled January 1977)		NA	7.4	NA	NA	NA	NA	NA	NA	NA	NA
Old Lindsay Public Supply Well (Sampled 01/28/83)		NA	7.2	NA	NA	NA	NA	NA	NA	NA	NA
15261 (Sampled 01/28/83)		NA	7.0	NA	NA	0.11	3.1	U	U	NA	U
15262 (Sampled 01/28/83)		NA	7.1	NA	NA	0.11	14.0	U	U	NA	U
Samples Collected November 2001											
87-3	01-19700-DU60D	6.35	6.6 J	11.5	949	0.219	34	0.002 U	0.009	0.08	0.001 U
89-14	01-19697-DU60A	5.88	6.3 J	11.6	660	10.1	170	0.003	0.027	3.31	0.005
89-15	01-19698-DU60B	5.02	4.8 J	12.6	2010	127	1100	0.007	0.01 U	33.3	0.001 U
92-3A	01-19786-DU75A	6.75	6.9 J	11.7	569	0.030	26	0.002 U	0.102	3.63	0.002
92-3B	01-19787-DU75B	6.41	6.5 J	12.2	724	0.006 U	170	0.002 U	0.087	1.68	0.001 U
Preister's Domestic (Before)	01-19701-DU60E	6.84	7.0 J	16.1	949	0.046	130	0.002 U	0.005 U	0.05 U	0.001 U
Preister's Domestic (After)	01-19702-DU60F	6.98	7.1 J	16.5	951	0.019	130	0.002 U	0.005 U	0.05 U	0.001 U
Samples Collected February 2002											
87-3	02-1446-EB74D	6.60	6.7 J	12.2	766	0.136	25	0.002 U	0.012	0.11	0.001 U
89-14	02-1443-EB74A	5.82	5.8 J	10.5	690	16.1	360	0.004	0.019	2.42	0.003
89-15	02-1444-EB74B	6.18	6.2 J	10.5	1430	71.5	600	0.002	0.008	1.84	0.001 U
Preister's Domestic (Before)	02-1502-EB89A	6.63	7.0 J	9.0	981	0.009	120	0.002 U	0.005 U	0.05 U	0.001
Preister's Domestic (After)	02-1503-EB89B	6.80	7.1 J	10.1	970	0.008	140	0.002 U	0.005 U	0.05 U	0.001 U
Samples Collected May 2002											
87-3	02-6069-EJ19F	6.61	6.7 J	10.4	785	0.107	25	0.002 U	0.012 J	0.11	0.001 U
89-14	02-6066-EJ19C	5.61	5.2 J	14.2	1110	17.6	280	0.006	0.006 J	2.21	0.002 U
89-15	02-6067-EJ19D	6.58	6.5 J	13.9	1210	43.8	320	0.002	0.005 J	0.36	0.001 U
92-3A	02-6315-EJ54A	6.77	8.0 J	12.2	459	0.016	19 J	0.002 U	0.190 J	1.92	0.001 U
92-3B	02-6316-EJ54B	6.47	6.4 J	12.0	558	0.008	150	0.002 U	0.066 J	0.54	0.001 U
AOI Well	02-6070-EJ19G	6.39	6.4 J	13.8	381	2.05	46	0.002 U	0.005 UJ	0.14	0.001 U
OI Well	02-6068-EJ19E	6.67	6.7 J	11.9	726	12.5	210	0.002 U	0.005 UJ	0.25	0.001 U
Preister's Domestic (Before)	02-6317-EJ54C	6.92	6.9 J	13.8	818	0.020	170	0.002 U	0.011 J	0.05 U	0.004
Preister's Domestic (After)	02-6318-EJ54D	6.92	6.9 J	15.7	860	0.006	180	0.002 U	0.005 UJ	0.05 U	0.001 U

Table 3
Summary of Analytical Results for Inorganic Compounds
Fifty-Second through Fifty-Fifth Quarters
November 2001 through September 2002
Lindsay Manufacturing Company

Well ID	Lab ID	Field Measurements				Total Metals (mg/L)					
		pH (field)	pH (lab)	Water Temperature (°C) (field)	Specific Conductivity (umhos/cm) (field)	Zinc	Sulfate	Cadmium	Chromium	Iron	Lead
Federal MCL				NS	NS	5.0*		0.005	0.05		0.05
Alternate Cleanup Level[1] - On Property		≥ 5.0	≥ 5.0	NE	NE	NE	500	NE	NE	10	NE
Alternate Cleanup Level[1] - Off Property		≥ 6.3	≥ 6.3	NE	NE	NE	400	NE	NE	1	NE
Historical Data:											
Old Lindsay Public Supply Well (Sampled January 1977)		NA	7.4	NA	NA	NA	NA	NA	NA	NA	NA
Old Lindsay Public Supply Well (Sampled 01/28/83)		NA	7.2	NA	NA	NA	NA	NA	NA	NA	NA
15261 (Sampled 01/28/83)		NA	7.0	NA	NA	0.11	3.1	U	U	NA	U
15262 (Sampled 01/28/83)		NA	7.1	NA	NA	0.11	14.0	U	U	NA	U
Samples Collected August 2002											
87-3	02-10830-EQ82F	6.44	6.79 J	13.2	722	1.22	34	0.002 U	0.013	0.62	0.001 U
89-12	02-10825-EQ82A	6.25	NA	14.6	820	1.66	299	NA	NA	0.05 U	NA
89-13	02-10826-EQ82B	7.18	NA	14.1	513	NA	30	NA	NA	NA	NA
89-14	02-10827-EQ82C	6.26	6.26 J	14.1	858	10.5	200	0.004	0.005 U	1.16	0.001 U
89-15	02-10828-EQ82D	5.29	5.32 J	14.0	1330	71.2	580	0.007	0.006	19.1	0.001 U
Preister's Domestic (Before)	02-10832-EQ82H	6.52	7.20 J	15.5	820	0.009	87	0.002 U	0.005 U	0.05 U	0.001 U
Preister's Domestic (After)	02-10833-EQ82I	6.60	7.21 J	14.7	834	0.007	88	0.002 U	0.005 U	0.05 U	0.001 U

Notes:
* EPA secondary MCLs
NA = Not Analyzed or Not Available
NS = No Standard
NE = Not Established
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
Bold font indicates result reported is above or equal to the MCL (zinc, cadmium, chromium, or lead) or the applicable alternate cleanup level (pH, sulfate, iron).
[1] Reference letter from State of Nebraska to Lindsay Manufacturing Company dated 12/14/00

Table 4
Summary of Analytical Results for Organic Compounds
Fifty-Second through Fifty-Fifth Quarters
November 2001 through September 2002
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C^{o}) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
EPA MCL				NS	NS	7	NS	170	5	200	5	5	-
Alternate Cleanup Level [1] - On Property		≥ 5.0	≥ 5.0	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Alternate Cleanup Level [1] - Off Property		≥ 6.3	≥ 6.3	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Samples Collected November 2001													
87-3	01-19700-DU60D	6.35	6.6 J	11.5	949	19	5 U	5 U	5 U	30	5 U	5	54
89-12	01-19704-DU60H	6.47	NA	13.1	920	54	29	6	5 U	120	5 U	170	379
89-13	01-19705-DU60I	6.88	NA	11.3	456	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
89-14	01-19697-DU60A	5.88	6.3 J	11.6	660	5 U	5 U	5 U	5 U	8	5 U	5	13
89-15	01-19698-DU60B	5.02	4.8 J	12.6	2010	140	20	13	5 U	200	5 U	110	483
92-3A	01-19786-DU75A	6.75	6.9 J	11.7	569	12	5 U	5 U	5 U	100	5 U	42	154
92-3B	01-19787-DU75B	6.41	6.5 J	12.2	724	5 U	5 U	5 U	5 U	16	5 U	8	24
AOI Well	01-19706-DU60J	6.27	NA	13.9	463	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	01-19699-DU60C	6.44	NA	12.1	929	28	5 U	5 U	5 U	35	5 U	23	86
Preister's Domestic (Before)	01-19701-DU60E	6.84	7.0 J	16.1	949	38 J	4.7	2.2	0.3 J	77 J	0.5	37 J	159
Preister's Domestic (After)	01-19702-DU60F	6.98	7.1 J	16.5	951	1.2	1.0	0.2 U	0.2 U	5.8	0.2 U	0.2 U	8
Samples Collected February 2002													
87-3	02-1446-EB74D	6.60	6.7 J	12.2	766	22	5 U	5 U	5 U	30	5 U	6	58
89-12	02-1450-EB74H	6.43	NA	11.0	974	24	5 U	5 U	5 U	23	5 U	70	117
89-13	02-1451-EB74I	7.22	NA	9.7	528	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
89-14	02-1443-EB74A	5.82	5.8 J	10.5	690	5 U	5 U	5 U	5 U	5 U	5 U	6	6
89-15	02-1444-EB74B	6.18	6.2 J	10.5	1430	110	7	5 U	5 U	130	5 U	93	340
92-3A	02-1504-EB89C	6.79	NA	10.6	568	16	5 U	5 U	5 U	110	5 U	48	174
92-3B	02-1505-EB89D	6.45	NA	11.6	670	5 U	5 U	5 U	5 U	10	5 U	6	16
AOI Well	02-1448-EB74F	6.28	NA	13.5	379	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	02-1445-EB74C	6.73	NA	11.3	642	20	5 U	5 U	5 U	9	5 U	32	61
Preister's Domestic (Before)	02-1502-EB89A	6.63	7.0 J	9.0	981	51	5.2	2.4	1.0 U	94	1.0 U	49	202
Preister's Domestic (After)	02-1503-EB89B	6.80	7.1 J	10.1	970	1.1	0.6	0.2 U	0.2 U	3.6	0.2 U	0.2 U	5.3
Samples Collected March 2002													
89-12	02-3391-EB94A	6.35	NA	14.0	967	44	16	5 U	5 U	70	5 U	150	280

Table 4
Summary of Analytical Results for Organic Compounds
Fifty-Second through Fifty-Fifth Quarters
November 2001 through September 2002
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C°) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
EPA MCL				NS	NS	7	NS	170	5	200	5	5	-
Alternate Cleanup Level [1] - On Property		≥ 5.0	≥ 5.0	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Alternate Cleanup Level [1] - Off Property		≥ 6.3	≥ 6.3	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Samples Collected May 2002													
87-3	02-6069-EJ19F	6.61	6.7 J	10.4	785	14	5 U	5 U	5 U	22	5 U	5	41
89-12	02-6064-EJ19A	6.67	NA	12.2	1090	18	5 U	5 U	5 U	10	5 U	32	60
89-13	02-6065-EJ19B	6.73	NA	11.6	536	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
89-14	02-6066-EJ19C	5.61	5.2 J	14.2	1110	5 U	5 U	5 U	5 U	5	5 U	7	12
89-15	02-6067-EJ19D	6.58	6.5 J	13.9	1210	67	5 U	5 U	5 U	89	5 U	56	212
92-3A	02-6315-EJ54A	6.77	8.0 J	12.2	459	5 U	5 U	5 U	5 U	97	5 U	42	139
92-3B	02-6316-EJ54B	6.47	6.4 J	12.0	558	5 U	5 U	5 U	5 U	11	5 U	6	17
AOI Well	02-0670-EJ19G	6.39	6.4 J	13.8	381	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	02-6068-EJ19E	6.67	6.7 J	11.9	726	18	5 U	5 U	5 U	7	5 U	33	58
Preister's Domestic (Before)	02-6317-EJ54C	6.92	6.9 J	13.8	818	80	7.2	3.1	1.0 U	130	1.0 U	63	283
Preister's Domestic (After) [2]	02-6318-EJ54D	6.92	6.9 J	15.7	860	1.9	1.2	0.2 U	0.2 U	9.2	0.2 U	0.2 U	12
Samples Collected June 2002													
89-12	02-8175-EM04A	6.83	NA	13.5	949	19 J	5 UJ	5 UJ	5 UJ	11 J	5 UJ	28 J	58
Samples Collected August 2002													
87-3	02-10830-EQ82F	6.44	6.79 J	13.2	722	12 J	5 UJ	5 UJ	5 UJ	13 J	5 UJ	5 UJ	25
89-12	02-10825-EQ82A	6.25	NA	14.6	820	78 J	46 J	5 UJ	5 UJ	84 J	5 UJ	260 J	468
89-13	02-10826-EQ82B	7.18	NA	14.1	513	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	ND
89-14	02-10827-EQ82C	6.26	6.26 J	14.1	858	12 J	5 UJ	5 UJ	5 UJ	19 J	5 UJ	9 J	40
89-15	02-10828-EQ82D	5.29	5.32 J	14.0	1330	180 J	54 J	30 J	5 UJ	290 J	5 UJ	170 J	744
92-3A	02-11036-EQ96A	6.58	NA	12.0	547	10	5 U	5 U	5 U	77 J	5 U	23	110
92-3B	02-11037-EQ96B	5.76	NA	12.9	711	5 U	5 U	5 U	5 U	12 J	5 U	5 U	12
AOI Well	02-10831-EQ82G	6.09	NA	12.9	475	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	ND
OI Well	02-10829-EQ82E	6.32	NA	11.6	1207	120 J	45 J	16 J	5 UJ	290 J	5 UJ	110 J	581
Preister's Domestic (Before)	02-10832-EQ82H	6.52	7.20 J	15.5	820	30 J	3.0 J	3 UJ	3 UJ	54 J	3 UJ	30 J	117
Preister's Domestic (After) [2]	02-10833-EQ82I	6.60	7.21 J	14.7	834	31 J	4.3 J	1.0 J	0.2 UJ	69 J	0.2 UJ	0.2 UJ	105
Samples Collected September 2002													
Preister's Domestic (Before)	02-14197-EV12A	NA	NA	NA	NA	29	2.8	1.0	1.0 U	53	1.0 U	24	110
Preister's Domestic (After)	02-14198-EV12B	NA	NA	NA	NA	26	3.4	1.0 U	1.0 U	49	1.0 U	1.0 U	78
Beiler's Domestic (After)	02-14199-EV12C	NA	NA	NA	NA	1.4	1 U	1 U	1 U	1.8	1 U	4.2	7.4
Beiler's Stock Well	02-14200-EV12D	NA	NA	NA	NA	21	6.9	1 U	1 U	29	1 U	65	122

Notes:
NA = Not Analyzed or Not Available
ND = Not Detected
NS = No Standard
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
Bold font indicates result reported is above or equal to the MCL.

[1] Reference letter from State of Nebraska to Lindsay Manufacturing Company dated 12/14/00

[2] Methylene Chloride (0.4 ug/L) and acetone (1.2 ug/L) were reported in the May 2002 sample and acetone (2.6 ug/L) in the August 2002 sample. These compounds are believed to be the result of laboratory contamination and not representative of the sample.

1,1-DCE = 1,1-Dichloroethene
1,1-DCA = 1,1-Dichloroethane
1,2-DCE = total of cis-1,2-dichloroethene and trans-1,2-dichloroethene
1,2-DCA = 1,2-Dichloroethane
1,1,1-TCA = 1,1,1-Trichloroethane
TCE = Trichloroethene
PCE = Tetrachloroethene

Table 5
Summary of Analytical Results for HRC Injection Monitoring Parameters
August 2001 through August 2002
Lindsay Manufactering Company

Well ID	Field Measurements						Laboratory Analyses							
	pH (field)	pH (lab)	Water Temperature (°C) (field)	Specific Conductivity (umhos/cm) (field)	Dissolved Oxygen (mg/l)	Oxidation/Reduction Potential (mv)	Sulfate (mg/l)	Sulfide (mg/l)	Dissolved Iron (mg/l)	Total Iron (mg/l)	Nitrate as N (mg/l)	Nitrite as N (mg/l)	Orthophosphate as P (mg/l)	Aerobic Plate Count (cfu/ml)
Samples Collected August 2001 (information to complete design)														
89-12	6.06	NA	14.2	1,390	NA	NA	354	NA	NA	NA	13.5	0.02 UJ	0.34	90
89-13	7.43	NA	12.8	578	NA	NA	32	NA	NA	NA	4.7	0.02 UJ	0.34	< 1
89-14	6.07	6.2 J	14.0	969	9.59	128	358/240 *	NA	NA	5.66	4.4	0.05 J	0.05 U	5,700
89-15	4.92	4.6 J	15.1	1,998	8.73	207	1173/1200 *	NA	NA	56.4	12.7	0.03 J	0.05 U	< 1
Samples Collected November 2001														
89-12	6.47	NA	13.1	920	10.1	262	253	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-13	6.88	NA	11.3	456	10.3	242	34	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-14	5.88	6.3 J	11.6	660	13.8	164	170	1.0 U	0.61	3.31	NA	NA	NA	NA
89-15	5.02	4.8 J	12.6	2,010	4.05	181	1100	1.0 U	38.8	33.3	NA	NA	NA	NA
Samples Collected February 2002														
89-12	6.43	NA	11.0	974	NA	225	170	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-13	7.22	NA	9.7	528	11	108	37	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-14	5.82	5.8 J	10.5	690	9.89	172	360	1.0 U	0.01 U	2.42	NA	NA	NA	NA
89-15	6.18	6.2 J	10.5	1,430	6.93	137	600	1.0 U	0.01 U	1.84	NA	NA	NA	NA
Samples Collected May 2002														
89-12	6.67	NA	12.2	1090	2.38	263	122	2.0 U	0.01 U	NA	NA	NA	NA	NA
89-13	6.73	NA	11.6	536	10.61	103	35	2.0 U	0.01 U	NA	NA	NA	NA	NA
89-14	5.61	5.2 J	14.2	1110	10.54	145	280	2.0 U	1.18	2.21	NA	NA	NA	NA
89-15	6.58	6.5 J	13.9	1210	7.06	124	320	2.0 U	0.01 U	0.36	NA	NA	NA	NA
Samples Collected August 2002														
89-12	6.25	NA	14.6	820	5.2	192	299	1.0 U	0.01 U	0.05 U	NA	NA	NA	NA
89-13	7.18	NA	14.1	513	11.75	97	30	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-14	6.26	6.26 J	14.1	858	8.65	65	200	1.0 U	0.37	1.16	NA	NA	NA	NA
89-15	5.29	5.32 J	14.0	1330	8.01	150	580	1.0 U	15	19.1	NA	NA	NA	NA

Notes:
NA = Not Analyzed or Not Available
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
* Samples were submitted for this test to Midwest Laboratories, Inc. in Omaha, NB and Analytical Resources, Inc. in Seattle, WA

URS

January 30, 2003

Ms. Diane Easley
EPA Project Coordinator
United States Environmental Protection Agency
Superfund Division
726 Minnesota Avenue
Kansas City, KS 66101

Technical Information
Water Levels, Pumping Records, and Concentration Trends
Lindsay Manufacturing Facility
Groundwater Remediation
Lindsay, Nebraska
URS Job No.: 33750799

Dear Ms. Easley:

On behalf of Lindsay Manufacturing, URS Corporation (URS) is submitting this letter in response to the following questions addressed to Bob Jacobson with Lindsay in a phone conversation on January 16, 2003:

1) Why do the concentrations of VOCs persist at monitoring well 89-15? and

2) Why did the concentration of VOCs "spike" at the OIW in August 2002?

Additionally, attachments are included that summarize water elevation data collected over the past five years (1997 through 2002) and pumping volumes for well 89-12 from June through September 2002 as you requested.

Water levels in the Sand & Gravel aquifer (aquifer) fluctuate each summer based on seasonal irrigation demand. During the irrigation season, water levels decrease as irrigation increases. As the water levels drop, groundwater in the perched sand channel and in the silty clays between the sand channel and the aquifer, drain in part to the aquifer. The silty clays between the sand channel and the aquifer contain chlorinated solvent residuum that continues to release to the aquifer. With the exception of 1997, climatic conditions were wet in the mid to late 1990s and irrigation was infrequent. The recent drought years (2000- 002) have resulted in wider seasonal fluctuations in water levels in the aquifer as shown in Figure 1. Water elevations from April 1997 through November 2002 for wells 89-15 (on-property), 87-3 (downgradient of 89-15, near south property boundary), 92-3A, and 92-3B (located downgradient of Lindsay) are plotted to demonstrate the changes in aquifer water levels associated with irrigation demand. Water levels collected at the monitoring wells associated with the Lindsay site remediation from April 1997 through November 2002 are summarized in Table 1.

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As the water levels in the aquifer drop, groundwater drains through the sand channel and the silty clays into the Sand & Gravel aquifer. The chlorinated volatile organic compounds (VOCs) migrate downward with the groundwater and are detected at wells 89-15 and OIW. Both of these wells are screened in the aquifer below the silty clays that contain solvent residuum. Once in the aquifer, the VOCs are transported downgradient and detected at well 89-12. Well 89-12 is completed in the aquifer but beyond the residual source area influence of the sand channel and the silty clays. The concentrations of total VOCs detected at wells 89-15, OIW, and 89-12 from May 1998 through November 2002 are shown on Figure 2. VOC concentrations peaked in August of 2000, 2001, and 2002 at all three wells. These increases are associated with the drop in water levels in the aquifer due to irrigation during the summer and consequent drainage of residuum into the aquifer. The increase in VOC concentrations is more notable in heavy irrigation (dry) years (2000-2002) and may not be as noticeable during wetter years. Generally, concentrations of VOCs decrease as the irrigation season closes and the aquifer levels begin to recover (water elevations increase). The reversal in detected concentrations of VOCs in the fall and winter reflects the rising aquifer water levels upward into the silty clays. The rise slows the drainage to the aquifer.

Well 89-15 is located nearest the residuum and VOC concentrations detected at this well are the best indicator of the downward transport of VOCs from the residuum to the aquifer. The screen in this well is located in the upper portion of the aquifer and concentrations measured would be minimally influenced by upgradient water. VOCs will continue to be detected at this well until the residuum in the silty clays is removed. The VOC concentrations detected at the end of each irrigation season will be higher in years when water levels in the aquifer decrease as noted on Figure 2. However, based on the lower concentrations detected in August 2002 as compared to August 2001, the drought is enhancing the removal of residuum from the silty clays beneath the sand channel.

VOC concentrations measured at the OIW, located downgradient of 89-15, also are indicative of the downward transport of VOCs through the silty clays, but this well is screened over a wider thickness of the aquifer and concentrations may be influenced (diluted) by the greater volume of water screened. The "spike" observed at the OIW in August 2002 and the substantial drop in concentration in November 2002 is indicative of a "slug" of residuum that has migrated through the silty clays as the result of decreased water levels in 2000, 2001, and 2002.

VOC concentrations detected at 89-12 are not the result of drainage from directly above, but are indicative of the downgradient migration of VOCs across the site. These detections are influenced by dispersion as the VOCs are transported along the top of the aquifer. Monitoring well 89-12 is used as an interceptor well during the irrigation season to capture the VOCs. As noted at 89-15 and OIW, the concentrations at 89-12 tend to peak in August and decrease with the end of the irrigation season, but in 2002, the concentration of VOCs detected in November are slightly above the August levels. The November 2002 data indicate that a longer period of drainage at higher concentrations of VOCs entered the aquifer (as observed at 89-15 and OIW). This downgradient transport is observed beyond the irrigation season consistent with the decrease in water levels in 2002 and a longer recovery time to reach pre-irrigation water levels.

In September 2001, HRC was injected in the sand channel in an east/west line near well 89-15 and a north/south line located near the OIW to "polish" the residual VOCs in the silty clays. The injection was

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conducted at the end of the irrigation season to allow a longer residence time in the soils beneath the sand channel. An observable effect of the HRC was not expected until after the 2002 irrigation season due to the transport time for groundwater in the sand channel to travel through the silty clays making contact with HRC. As of August 2002, there was not a definite change in water chemistry to indicate that the groundwater in contact with the HRC injected in the sand channel had drained to the aquifer. However, the intensity of the 2002 irrigation season likely has enhanced this downward movement and changes may be more apparent with sampling conducted in 2003. Data collected during quarterly monitoring from November 2001 (after the HRC injection) through November 2002 are summarized in Tables 2 and 3.

Well 89-12 was pumped during the summer as part of the on-going remediation. The tabulated pumping volumes are included in Table 4.

We hope that the information presented in this letter addresses your questions, but should you need additional explanation, please do not hesitate to contact URS at your convenience.

Very truly yours,
URS CORPORATION

Karen L. Mixon
Task Manager

Roy W. Elliott
Vice President

Cc: Bob Jacobson, Lindsay Manufacturing
Rick Wade, McGuire & Norby

Table 1

Groundwater Elevations - Monitoring Wells

April 1997 through November 2002

Lindsay Manufacturing Company

(Well ID)	Reference Elevation (ft above msl)	April 30,1997		May 29,1997		June 27,1997		July 16, 1997		August 22, 1997		September 5, 1997		October 10,1997		November 7,1997	
		Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation
MW87-3	1697.72	47.32	1650.40	47.97	1649.75	48.52	1649.20	56.06	1641.66	59.37	1638.35	67.84	1629.88	56.27	1641.45	52.77	1644.95
MW89-12	1675.47	24.50	1650.97	25.06	1650.41	25.46	1650.01	33.78	1641.69	35.96	1639.51	39.14	1636.33	34.42	1641.05	30.03	1645.44
MW89-13	1674.67	23.53	1651.14	23.80	1650.87	23.06	1651.61	24.95	1649.72	31.45	1643.22	33.04	1641.63	31.70	1642.97	29.66	1645.01
MW89-14	1679.66	28.20	1651.46	28.17	1651.49	27.77	1651.89	28.69	1650.97	32.82	1646.84	33.93	1645.73	34.30	1645.36	33.37	1646.29
MW89-15	1678.75	26.70	1652.05	27.29	1651.46	28.51	1650.24	31.05	1647.70	37.80	1640.95	40.07	1638.68	38.06	1640.69	32.33	1646.42
MW92-3A	1701.45	54.13	1647.32	54.99	1646.46	56.98	1644.47	63.72	1637.73	67.63	1633.82	67.28	1634.17	61.35	1640.10	59.38	1642.07
MW92-3B	1701.79	54.45	1647.34	55.27	1646.52	57.34	1644.45	64.10	1637.69	67.82	1633.97	67.59	1634.20	61.71	1640.08	59.75	1642.04
OIW	1675.75	24.26	1650.99	24.80	1650.45	25.06	1650.19	28.70	1646.55	35.48	1639.77	38.02	1637.23	51.00	1624.25	29.90	1645.35
AOIW	1696.23	45.90	1650.33	46.47	1649.76	47.02	1649.21	53.90	1642.33	58.05	1638.18	75.89	1620.34	55.39	1640.84	51.40	1644.83

MSL - Mean Sea Level
NA - Not Available
Information for November 1999, February 2000, and May 2000 is not retrievable

Table 1

Groundwater Elevations - Monitoring Wells

April 1997 through November 2002

Lindsay Manufacturing Company

(Well ID)	Reference Elevation (ft above msl)	February, 1998		May, 1998		August, 1998		November, 1998		February, 1999		May, 1999		August, 1999		August, 2000		November, 2000	
		Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation
MW87-3	1697.72	52.20	1645.52	50.35	1647.37	53.60	1644.12	48.40	1649.32	46.80	1650.92	45.10	1652.62	49.45	1648.27	64.22	1633.50	50.89	1646.83
MW89-12	1675.47	30.33	1645.14	26.94	1648.53	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW89-13	1674.67	27.60	1647.07	24.24	1650.43	26.40	1648.27	24.35	1650.32	22.85	1651.82	21.35	1653.32	21.59	1653.08	29.90	1644.77	25.53	1649.14
MW89-14	1679.66	31.62	1648.04	28.90	1650.76	28.69	1650.97	27.60	1652.06	26.50	1653.16	25.14	1654.52	24.00	1655.66	29.60	1650.06	28.12	1651.54
MW89-15	1678.75	34.10	1644.65	28.90	1649.85	30.20	1648.55	24.37	1654.38	22.60	1656.15	20.80	1657.95	23.95	1654.80	36.90	1641.85	26.77	1651.98
MW92-3A	1701.45	57.20	1644.25	56.23	1645.22	62.59	1638.86	55.25	1646.20	44.60	1656.85	51.85	1649.60	59.21	1642.24	72.65	1628.80	52.75	1648.70
MW92-3B	1701.79	57.63	1644.16	56.63	1645.16	62.98	1638.81	55.65	1646.14	54.00	1647.79	52.20	1649.59	59.60	1642.19	72.80	1628.99	58.12	1643.67
OIW	1675.25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
AOIW	1696.23	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

MSL - Mean Sea Level
NA - Not Available
Information for November 1999, February 2000, and May 2000 is not retrievable

Table 1

Groundwater Elevations - Monitoring Wells

April 1997 through November 2002

Lindsay Manufacturing Company

(Well ID)	Reference Elevation (ft above msl)	February, 2001		May, 2002		August, 2001		November, 2001		February, 2002		May, 2002		August, 2002		November, 2002	
		Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation	Depth (feet)	Elevation
MW87-3	1697.72	48.83	1648.89	46.33	1651.39	62.50	1635.72	51.60	1646.12	48.66	1649.06	47.30	1650.42	60.15	1637.57	55.95	1641.77
MW89-12	1675.47	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW89-13	1674.67	24.50	1650.17	21.33	1653.34	30.30	1644.37	27.20	1647.47	24.65	1650.02	23.11	1651.56	32.64	1642.03	31.75	1643.42
MW89-14	1679.66	27.40	1652.26	24.30	1655.36	38.40	1641.26	29.38	1650.28	27.95	1651.70	26.60	1653.06	32.45	1647.21	33.50	1645.76
MW89-15	1678.75	24.83	1653.92	21.93	1656.82	37.32	1641.43	27.30	1651.45	24.42	1654.33	23.05	1655.70	34.95	1643.80	34.22	1644.53
MW92-3A	1701.45	55.57	1645.88	53.03	1648.42	65.57	1635.88	58.13	1643.32	55.36	1646.09	53.85	1647.60	70.30	1631.15	61.80	1639.65
MW92-3B	1701.79	55.95	1645.84	53.42	1648.37	65.91	1635.88	58.45	1643.34	56.10	1645.69	54.25	1647.54	70.64	1631.15	62.15	1639.64
OIW	1675.25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
AOIW	1696.23	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

MSL - Mean Sea Level
NA - Not Available
Information for November 1999, February 2000, and May 2000 is not retrievable

Table 2
Summary of Analytical Results for Organic Compounds
Fifty-Second through Fifty-Sixth Quarters
November 2001 through November 2002
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C°) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
EPA MCL				NS	NS	7	NS	170	5	200	5	5	-
Alternate Cleanup Level [1] - On Property		≥ 5.0	≥ 5.0	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Alternate Cleanup Level [1] - Off Property		≥ 6.3	≥ 6.3	NE	NB	NE	NE	NE	NE	NE	NE	NE	-
Samples Collected November 2001													
87-3	01-19700-DU60D	6.35	6.6 J	11.5	949	19	5 U	5 U	5 U	30	5 U	5	54
89-12	01-19704-DU60H	6.47	NA	13.1	920	54	29	6	5 U	120	5 U	170	379
89-13	01-19705-DU60I	6.88	NA	11.5	456	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
89-14	01-19697-DU60A	5.88	6.3 J	11.6	660	5 U	5 U	5 U	5 U	8	5 U	5	13
89-15	01-19698-DU60B	5.02	4.8 J	12.6	2010	140	20	13	5 U	200	5 U	110	483
92-3A	01-19786-DU75A	6.75	6.9 J	11.7	569	12	5 U	5 U	5 U	100	5 U	42	154
92-3B	01-19787-DU75B	6.41	6.5 J	12.2	724	5 U	5 U	5 U	5 U	16	5 U	8	24
AOI Well	01-19706-DU60J	6.27	NA	13.9	463	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	01-19699-DU60C	6.44	NA	12.1	929	28	5 U	5 U	5 U	35	5 U	23	86
Preister's Domestic (Before)	01-19701-DU60E	6.84	7.0 J	16.1	949	38 J	4.7	2.2	0.3 J	77 J	0.5	37 J	159
Preister's Domestic (After)	01-19702-DU60F	6.95	7.1 J	16.5	951	1.2	1.0	0.2 U	0.2 U	5.8	0.2 U	0.2 U	8
Samples Collected February 2002													
87-3	02-1446-EB74D	6.60	6.7 J	12.2	766	22	5 U	5 U	5 U	30	5 U	6	58
89-12	02-1450-EB74H	6.43	NA	11.0	974	24	5 U	5 U	5 U	23	5 U	70	117
89-13	02-1451-EB74I	7.22	NA	9.7	528	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
89-14	02-1443-EB74A	5.82	5.8 J	10.5	690	5 U	5 U	5 U	5 U	5 U	5 U	6	6
89-15	02-1444-EB74B	6.18	6.2 J	10.5	1430	110	7	5 U	5 U	130	5 U	93	340
92-3A	02-1504-EB89C	6.79	NA	10.6	568	16	5 U	5 U	5 U	110	5 U	48	174
92-3B	02-1505-EB89D	6.45	NA	11.6	670	5 U	5 U	5 U	5 U	10	5 U	6	16
AOI Well	02-1448-EB74F	6.28	NA	13.5	379	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	02-1445-EB74C	6.73	NA	11.3	642	20	5 U	5 U	5 U	9	5 U	32	61
Preister's Domestic (Before)	02-1502-EB89A	6.63	7.0 J	9.0	981	51	5.2	2.4	1.0 U	94	1.0 U	49	202
Preister's Domestic (After)	02-1503-EB89B	6.80	7.1 J	10.1	970	1.1	0.6	0.2 U	0.2 U	3.6	0.2 U	0.2 U	5.3
Samples Collected March 2002													
89-12	02-3391-EE94A	6.35	NA	14.0	967	44	16	5 U	5 U	70	5 U	150	280

Table 2
Summary of Analytical Results for Organic Compounds
Fifty-Second through Fifty-Sixth Quarters
November 2001 through November 2002
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C°) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
EPA MCL				NS	NS	7	NS	170	5	200	5	5	-
Alternate Cleanup Level [1] - On Property		≥ 5.0	≥ 5.0	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Alternate Cleanup Level [1] - Off Property		≥ 6.3	≥ 6.3	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Samples Collected May 2002													
87-3	02-6069-EJ19F	6.61	6.7 J	10.4	785	14	5 U	5 U	5 U	22	5 U	5	41
89-12	02-6064-EJ19A	6.67	NA	12.2	1090	18	5 U	5 U	5 U	10	5 U	32	60
89-13	02-6065-EJ19B	6.73	NA	11.6	536	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
89-14	02-6066-EJ19C	5.61	5.2 J	14.2	1110	5 U	5 U	5 U	5 U	5	5 U	7	12
89-15	02-6067-EJ19D	6.58	6.5 J	13.9	1210	67	5 U	5 U	5 U	89	5 U	56	212
92-3A	02-6315-EJ54A	6.77	8.0 J	12.2	459	5 U	5 U	5 U	5 U	97	5 U	42	139
92-3B	02-6316-EJ54B	6.47	6.4 J	12.0	558	5 U	5 U	5 U	5 U	11	5 U	6	17
AOI Well	02-6670-EJ19G	6.39	6.4 J	13.8	381	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	02-6068-EJ19E	6.67	6.7 J	11.9	726	18	5 U	5 U	5 U	7	5 U	33	58
Preister's Domestic (Before)	02-6317-EJ54C	6.92	6.9 J	13.8	818	80	7.2	3.1	1.0 U	130	1.0 U	63	283
Preister's Domestic (After) [2]	02-6318-EJ54D	6.92	6.9 J	15.7	860	1.9	1.2	0.2 U	0.2 U	9.2	0.2 U	0.2 U	12
Samples Collected June 2002													
89-12	02-8175-EM04A	6.83	NA	13.5	949	19 J	5 UJ	5 UJ	5 UJ	11 J	5 UJ	28 J	58
Samples Collected August 2002													
87-3	02-10830-EQ82F	6.44	6.79 J	13.2	722	12 J	5 UJ	5 UJ	5 UJ	13 J	5 UJ	5 UJ	25
89-12	02-10825-EQ82A	6.25	NA	14.6	820	78 J	46 J	5 UJ	5 UJ	84 J	5 UJ	260 J	468
89-13	02-10826-EQ82B	7.18	NA	14.1	513	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	ND
89-14	02-10827-EQ82C	6.26	6.26 J	14.1	858	12 J	5 UJ	5 UJ	5 UJ	19 J	5 UJ	9 J	40
89-15	02-10828-EQ82D	5.29	5.32 J	14.0	1330	180 J	54 J	50 J	5 UJ	290 J	5 UJ	170 J	744
92-3A	02-11036-EQ96A	6.58	NA	12.0	547	10	5 U	5 U	5 U	77 J	5 U	23	110
92-3B	02-11037-EQ96B	5.76	NA	12.9	711	5 U	5 U	5 U	5 U	12 J	5 U	5 U	12
AOI Well	02-10831-EQ82G	6.09	NA	12.9	475	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	ND
OI Well	02-10829-EQ82E	6.32	NA	11.6	1207	120 J	45 J	16 J	5 UJ	290 J	5 UJ	110 J	581
Preister's Domestic (Before)	02-10832-EQ82H	6.52	7.20 J	15.5	820	30 J	3.0 J	3 UJ	3 UJ	54 J	3 UJ	30 J	117
Preister's Domestic (After) [2]	02-10833-EQ82I	6.60	7.21 J	14.7	834	31 J	4.3 J	1.0 J	0.2 UJ	69 J	0.2 UJ	0.2 UJ	105
Samples Collected September 2002													
Preister's Domestic (Before)	02-14197-EV12A	NA	NA	NA	NA	29	2.8	1.0	1.0 U	53	1.0 U	24	110
Preister's Domestic (After)	02-14198-EV12B	NA	NA	NA	NA	26	3.4	1.0 U	1.0 U	49	1.0 U	1.0 U	78
Beller's Domestic (After)	02-14199-EV12C	NA	NA	NA	NA	1.4	1 U	1 U	1 U	1.8	1 U	4.2	7.4
Beller's Stock Well	02-14200-EV12D	NA	NA	NA	NA	21	6.9	1 U	1 U	29	1 U	65	122

Table 2
Summary of Analytical Results for Organic Compounds
Fifty-Second through Fifty-Sixth Quarters
November 2001 through November 2002
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C^{O}) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
EPA MCL				NS	NS	7	NS	170	5	200	5	5	-
Alternate Cleanup Level [1] - On Property		≥ 5.0	≥ 5.0	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Alternate Cleanup Level [1] - Off Property		≥ 6.3	≥ 6.3	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Samples Collected October 2002													
Preister's Domestic (PS, 10-14-02)	02-15259-EW83A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Preister's Domestic (PS, 10-29-02)	02-16080-EX88A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Preister's Stock [3]	02-14785-EV91B	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Doug Beller's Domestic	02-14784-EV91A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Ron Pfeifer's Domestic	02-15917-EX65A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Pat Pfeifer's (old Morvec well)	02-15918-EX65B	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Samples Collected November 2002													
87-3	02-16321-EY32I	6.58	6.78	11.6	920	17	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	8	25
89-12	02-16313-EY32A	6.37	NA	12.9	1172	74	33	7	5.0 U	110	5.0 U	280	504
89-13	02-16314-EY32B	7.29	NA	11.4	583	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	ND
89-14	02-16315-EY32C	6.51	5.87 J	11.3	754	8	5.0 U	5.0 U	5.0 U	15	5.0 U	11	34
89-15	02-16316-EY32D	5.63	5.70 J	11.5	1920	130	36	40	5.0 U	130	5.0 U	110	496
92-3A [4]	02-16403-EY52A	6.69	6.92 J	11.4	497	6	5.0 U	5.0 U	5.0 U	63	5.0 U	28	97
92-3B	02-16404-EY52B	6.50	6.53 J	11	651	5.0 U	5.0 U	5.0 U	5.0 U	9	5.0 U	6	15
AOI Well	02-16322-EY32J	6.18	NA	13	514	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	ND
OI Well	02-16317-EY32E	6.42	NA	12.8	830	35	8	5.0 U	5.0 U	59	5.0 U	35	137
Preister's Domestic (Before)	02-16407-EY52E	7.07	7.02 J	13.6	749	27	2.9	1.5	1.0 U	50	1.0 U	28	109
Preister's Domestic (After)	02-16408-EY52F	7.10	7.12 J	13.8	773	16	2.3	1.0 U	1.0 U	29	1.0 U	1.0 U	47
Preister's Domestic (PS, 11-12-02)	02-16661-EZ00A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Preister's Domestic (PS, 11-25-02)	02-17375-FA14A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Beller's Domestic (Before)	02-16318-EY32F	6.69	NA	14.8	906	2.2	1.3	1.0 U	1.0 U	2.8	1.0 U	1.2	7.5
Beller's Domestic (After)	02-16319-EY32G	6.74	NA	14	902	1.8	1.0	1.0 U	1.0 U	1.0 U	1.0 U	7	9.8
Beller's Stock	02-16320-EY32H	6.75	NA	10.9	825	20	7.8	1.0 U	1.0 U	30	1.0 U	86	144

Notes:
NA = Not Analyzed or Not Available
ND = Not Detected
NS = No Standard
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
PS = Collected at kitchen faucet after carbon filter/RO system.
Bold font indicates result reported is above or equal to the MCL.

1,1-DCE = 1,1-Dichloroethene
1,1-DCA = 1,1-Dichloroethane
1,2-DCE = total of cis-1,2-dichloroethene and trans-1,2-dichloroethene
1,2-DCA = 1,2-Dichloroethane
1,1,1-TCA = 1,1,1-Trichloroethane
TCE = Trichloroethene
PCE = Tetrachloroethene

[1] Reference letter from State of Nebraska to Lindsay Manufacturing Company dated 12/14/00

[2] Methylene Chloride (0.4 ug/L) and acetone (1.2 ug/L) were reported in the May 2002 sample and acetone (2.6 ug/L) in the August 2002 sample. These compounds are believed to be the result of laboratory contamination and not representative of the sample.

[3] Carbon tetrachloride was detected at 2.4 ug/L. The MCL is 5 ug/L.

[4] A field duplicate was collected at 92-3A. 1,1-DCE reported in the table is from the duplicate analysis. The concentration in the parent sample was <5 ug/L.

Table 3
Summary of Analytical Results for HRC Injection Monitoring Parameters
August 2001 through November 2002
Lindsay Manufacturing Company

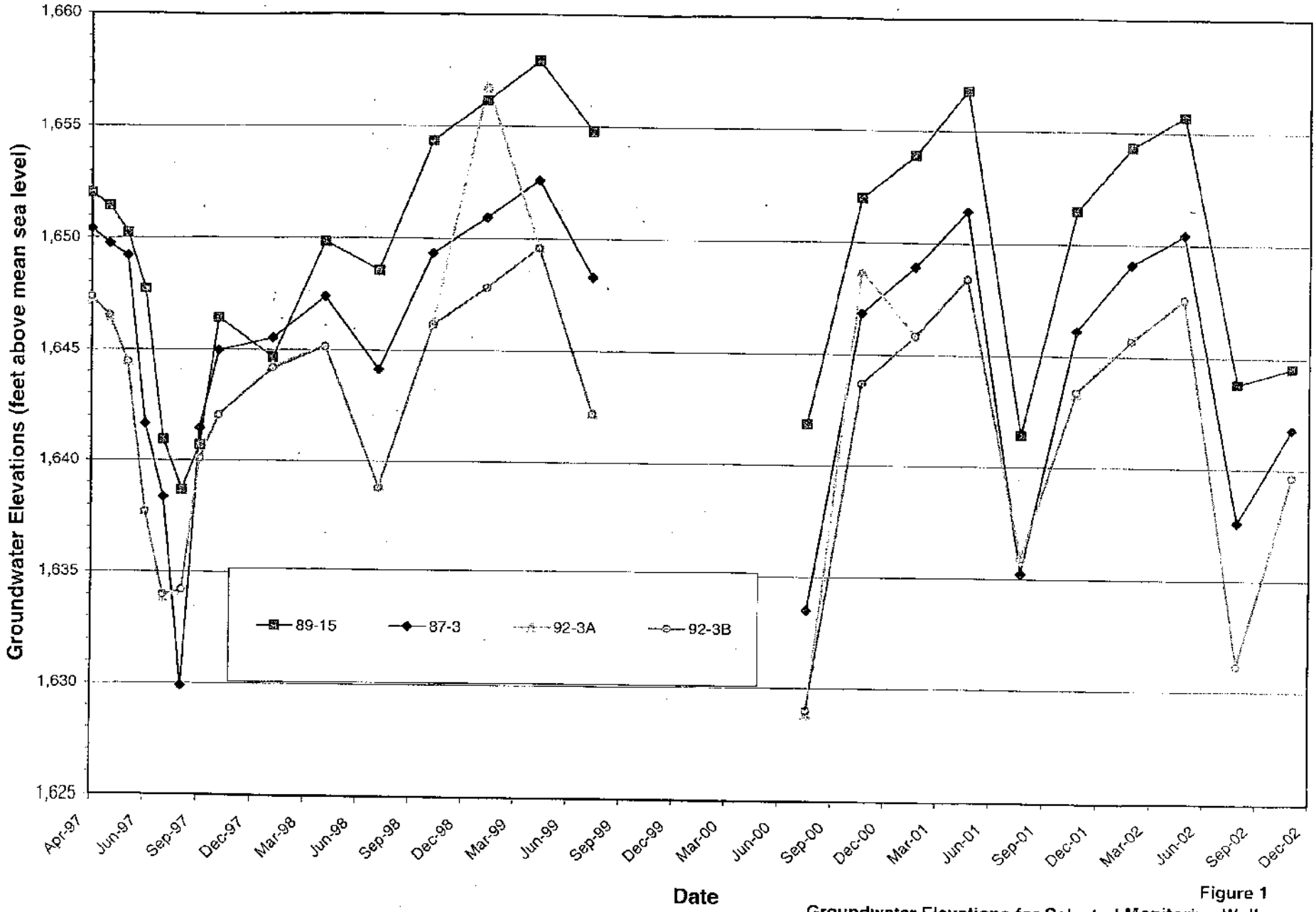
Well ID	Field Measurements						Laboratory Analyses							
	pH (field)	pH (lab)	Water Temperature (°C) (field)	Specific Conductivity (umhos/cm) (field)	Dissolved Oxygen (mg/l)	Oxidation/Reduction Potential (mv)	Sulfate (mg/l)	Sulfide (mg/l)	Dissolved Iron (mg/l)	Total Iron (mg/l)	Nitrate as N (mg/l)	Nitrite as N (mg/l)	Orthophosphate as P (mg/l)	Aerobic Plate Count (cfu/ml)
Samples Collected August 2001 (information to complete design)														
89-12	6.06	NA	14.2	1,390	NA	NA	354	NA	NA	NA	13.3	0.02 UJ	0.34	90
89-13	7.43	NA	12.8	578	NA	NA	32	NA	NA	NA	4.7	0.02 UJ	0.34	< 1
89-14	6.07	6.2 J	14.0	969	9.59	128	358/240 *	NA	NA	5.66	4.4	0.05 J	0.05 U	5,700
89-15	4.92	4.6 J	15.1	1,998	8.73	207	1173/1200 *	NA	NA	56.4	12.7	0.03 J	0.05 U	< 1
Samples Collected November 2001														
89-12	6.47	NA	13.1	920	10.1	262	253	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-13	6.88	NA	11.3	456	10.5	242	34	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-14	5.88	6.3 J	11.6	660	13.8	164	170	1.0 U	0.61	3.31	NA	NA	NA	NA
89-15	5.02	4.8 J	12.6	2,010	4.05	181	1100	1.0 U	38.8	33.3	NA	NA	NA	NA
Samples Collected February 2002														
89-12	6.43	NA	11.0	974	NA	225	170	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-13	7.22	NA	9.7	528	11	108	37	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-14	5.82	5.8 J	10.5	690	9.89	172	360	1.0 U	0.01 U	2.42	NA	NA	NA	NA
89-15	6.18	6.2 J	10.5	1,430	6.93	137	600	1.0 U	0.01 U	1.84	NA	NA	NA	NA
Samples Collected May 2002														
89-12	6.67	NA	12.2	1090	2.38	263	122	2.0 U	0.01 U	NA	NA	NA	NA	NA
89-13	6.73	NA	11.6	536	10.61	103	35	2.0 U	0.01 U	NA	NA	NA	NA	NA
89-14	5.61	5.2 J	14.2	1110	10.54	145	280	2.0 U	1.18	2.21	NA	NA	NA	NA
89-15	6.58	6.5 J	13.9	1210	7.06	124	320	2.0 U	0.01 U	0.36	NA	NA	NA	NA
Samples Collected August 2002														
89-12	6.25	NA	14.6	820	5.2	192	299	1.0 U	0.01 U	0.05 U	NA	NA	NA	NA
89-13	7.18	NA	14.1	513	11.75	97	30	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-14	6.26	6.26 J	14.1	858	8.65	65	200	1.0 U	0.37	1.16	NA	NA	NA	NA
89-15	5.29	5.32 J	14.0	1330	8.01	150	580	1.0 U	15	19.1	NA	NA	NA	NA
Samples Collected November 2002														
89-12	6.37	NA	12.9	1172	1.3	290	481	1.0 U	0.01 U	0.07	NA	NA	NA	NA
89-13	7.29	NA	11.4	583	12.15	148	32	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-14	6.51	5.87 J	11.3	754	11.78	167	150	1.0 U	0.01 U	1.08	NA	NA	NA	NA
89-15	5.63	5.70 J	11.5	1920	2.54	209	730	1.0 U	19.5	19.2	NA	NA	NA	NA

Notes:
NA = Not Analyzed or Not Available
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
* Samples were submitted for this test to Midwest Laboratories, Inc. in Omaha, NB and Analytical Resources, Inc. in Seattle, WA

Table 4
Summary of Pumping Volumes and pH
Fifty-Fourth and Fifty-Fifth Quarters
April 1, 2002 through September 30, 2002
Lindsay Manufacturing Company

	TIW		AOIW		OIW		MW 89-12		Total
	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Gallons
Monthly Summary									
April-02	0	NA	0	NA	0	NA	5,822	NA	5,822
May-02	0	NA	0	NA	0	NA	0	6.67	0
June-02	0	NA	0	NA	0	NA	2,043	6.83	2,043
July-02	0	NA	0	NA	0	NA	126,252	NA	126,252
August-02	0	NA	0	NA	0	NA	1,369,607	6.25	1,369,607
September-02	0	NA	0	NA	0	NA	1,091,617	NA	1,091,617
54th Quarter									
April, May, June 2002	0	NA	0	NA	0	NA	7,865	6.67	7,865
55th Quarter									
July, August, September 2002	0	NA	0	NA	0	NA	2,587,476	6.25	2,587,476
54th and 55th Quarters	0	NA	0	NA	0	NA	2,595,341	NA	2,595,341

NA Not Applicable or Not Analyzed



URS CORPORATION

K:\005\Lindsay\gw_elevations\GW_Elevations97-02 (Graph)
1/29/2003

Figure 1
Groundwater Elevations for Selected Monitoring Wells
89-15, 87-3, 92-3A, and 92-3B
Lindsay Manufacturing Company

URS

April 14, 2003

Ms. Diane Easley
EPA Project Coordinator
United States Environmental Protection Agency
Superfund Division
726 Minnesota Avenue
Kansas City, KS 66101

Enhanced Groundwater Remediation
Progress Report
U.S. v. Lindsay Manufacturing Company
C.A. 8:92-00015
URS Job No.: 33750799

Dear Ms. Easley:

Lindsay Manufacturing Company is pleased to submit this Enhanced Groundwater Remediation Progress Report summarizing the Consent Decree items completed or undertaken during the period from October 1, 2002 to March 31, 2003. This report presents a summary of groundwater remedial pumping and analytical results from the fifty-sixth (November 2002) and fifty-seventh (February 2003) quarterly rounds of groundwater sampling. Also included in this report are the additional data collected as part of the on-going monitoring associated with the Hydrogen-Releasing Compound (HRC) remedial treatment performed in September 2001 as described in *Work Plan, Polishing Upper Aquifer Water, Lindsay Manufacturing Facility, Lindsay, Nebraska* (Work Plan) dated May 25, 2001 and associated amendments.

REMEDIAL PUMPING

During the fifty-sixth and fifty-seventh quarters, converted monitoring well MW89-12 was the only well operated within the interceptor system. MW89-12 was shut down for the winter on October 2, 2002. The total gallons pumped in October 2002 are presented in Table 1. Pumping of MW89-12 is scheduled to resume on May 1, 2003.

GROUNDWATER MONITORING

Groundwater samples were collected in November 2002 (fifty-sixth quarter) and February 2003 (fifty-seventh quarter). Additional samples were collected in October and December 2002 and January and March 2003 as noted in the summary of wells sampled and the analytical program presented in Table 2. The additional samples were collected to address concerns of residents located downgradient of the Lindsay facility. Sample locations are shown on Figures 1 and 2. Samples were analyzed for volatile organic compounds (VOCs), metals and sulfate in accordance with the modified Statement of Work (SOW) associated with the Consent Decree. Field measurements for pH, temperature and specific conductivity were recorded at the time of sample collection. Laboratory analytical results and field measurements are summarized in Tables 3 and 4. Additionally, as part of the on-going monitoring for the HRC remedial treatment, samples from

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wells MW89-12, MW89-13, MW89-14 and MW89-15 were analyzed for dissolved oxygen (DO), oxidation-reduction potential (ORP), sulfate, sulfide and dissolved iron. These parameters provide a mechanism to monitor the consumption of HRC and are summarized in Table 5.

Copies of data validation memoranda and laboratory data pages are included in Appendix A of this report. Analytical anomalies were not identified during the data validation process.

Sample analytical data for VOCs, zinc, cadmium, chromium and lead were compared to established cleanup levels identified in the SOW associated with the Consent Decree. The cleanup levels primarily consist of federal maximum contaminant levels (MCLs) and secondary MCLs as described below. Sulfate, iron and pH were compared to alternate cleanup levels agreed upon by the State of Nebraska, EPA and Lindsay Manufacturing in December 2000.

PERCHED SAND CHANNEL

Groundwater quality in the perched sand channel located beneath the Lindsay facility is monitored by wells MW89-13 and MW89-14. Monitoring well MW89-13 was not sampled for metals and inorganic parameters during the fifty-sixth and fifty-seventh quarterly monitoring except as specified for the HRC treatment monitoring. The results of this monitoring are described in section "MONITORING PARAMETERS FOR HRC TREATMENT" of this report. Samples were collected for metals and inorganic parameters from MW89-14.

Zinc concentrations in groundwater collected from monitoring well MW89-14 were above the federal MCL (5.0 mg/l) during the fifty-sixth and fifty-seventh quarters and ranged from 6.7 to 7.1 mg/l, slightly below the previous two quarters. Cadmium, chromium, and lead were not detected or detected below the MCLs during the fifty-sixth and fifty-seventh quarters. Sulfate, pH and iron were below or within the acceptable range of the alternate cleanup levels for on-property wells.

Samples for VOC analysis were collected from both MW89-13 and MW89-14 during the fifty-sixth and fifty-seventh quarters. VOCs were not detected above cleanup levels at MW89-13 during the fifty-sixth and fifty-seventh quarters. Tetrachloroethene (PCE) was detected above the MCL (5 ug/l) in samples collected from well MW89-14 during the fifty-sixth and fifty-seventh quarters and ranged in concentration from 6 ug/l to 11 ug/l, similar to the previous two quarters. 1,1-Dichloroethene (1,1-DCE) was detected above the MCL (7 ug/l) in the sample collected during the fifty-sixth quarter at a concentration of 8 ug/l. 1,1,-DCE was not detected above the MCL during the fifty-seventh quarter. 1,1,1-Trichloroethane (1,1,1-TCA), 1,2-dichloroethene (1,2-DCE), 1,2-dichloroethane (1,2-DCA), and trichloroethene (TCE) were not detected or detected below MCLs at MW89-13 and MW89-14. 1,1-Dichloroethane (1,1-DCA) was not detected in samples from either well. A cleanup level has not been established for 1,1-DCA. The concentration of total VOCs detected at well MW89-13 remained low to not detected. The concentration of total VOCs detected at well MW89-14 continuously decreased during the fifty-sixth (34 ug/l) and fifty-seventh (6 ug/l) quarters from the August 2002 high of 40 ug/l.

SAND AND GRAVEL AQUIFER

Groundwater quality in the Sand & Gravel Aquifer is monitored beneath the Lindsay facility at wells MW89-15, MW89-12, MW87-3, OIW, and AOIW, and downgradient of the facility at MW92-3A, MW92-3B, and the Preister Domestic well.

Samples were collected for metals and inorganic parameters at MW87-3, MW89-15, and the Preister Domestic well during the fifty-sixth and fifty-seventh quarters. Samples were collected at MW92-3A and MW92-3B during the fifty-sixth quarter. Monitoring well MW89-12 was sampled for total zinc and iron during the fifty-sixth quarter. Samples were also collected at MW89-12 and MW89-15 during both quarters for parameters associated with the HRC treatment monitoring. The results of this monitoring are described in section "MONITORING PARAMETERS FOR HRC TREATMENT" of this report.

Concentrations of zinc, cadmium, chromium and lead detected in wells completed in the Sand & Gravel Aquifer were below MCLs with the exception of groundwater collected from wells MW89-15, MW92-3A, and MW92-3B. Zinc and cadmium in groundwater collected from well MW89-15 during the fifty-sixth and fifty-seventh quarters were above their associated MCLs. Chromium was detected above the MCL during the fifty-sixth quarter in samples collected from wells MW92-3A and MW92-3B.

The alternate cleanup level for on-property wells for sulfate and iron was exceeded during the fifty-sixth quarter in groundwater collected from MW89-15. The alternate cleanup level for off-property wells for iron was exceeded during the fifty-sixth quarter in groundwater collected from MW92-3A and MW92-3B. The pH generally ranged from 6.0 to 7.0 in groundwater collected from the aquifer. However, the samples collected from monitoring well MW89-15 during the fifty-sixth and fifty-seventh quarters had pH measurements of 5.6 and 5.9, respectively. These measurements are within the limitations of the alternate cleanup level for on-property wells.

Samples for VOCs were collected at all wells included in the monitoring program during the fifty-sixth and fifty-seventh quarters. 1,1-DCE, 1,1,1-TCA and PCE were detected in several wells during both quarterly sampling rounds. 1,1-DCE and/or PCE were above MCLs in wells MW87-3, MW89-12, MW89-15, MW92-3A, and OIW during both quarterly sampling rounds. PCE was above the MCL in groundwater collected from MW92-3B during the fifty-sixth quarter. There were no MCL exceedances at MW92-3B during the fifty-seventh quarter. 1,1,1-TCA was not detected or below the MCL in wells sampled during this biannual period.

1,2-DCE and 1,2-DCA were not detected or detected below MCLs. TCE was not detected or detected below the MCL with one exception. TCE was detected at MW89-12 during the fifty-seventh quarter at a concentration equal to the MCL. 1,1-DCA was detected at MW89-15, MW89-12, and the OIW. No MCL or cleanup level has been established for 1,1-DCA.

Samples were collected from the Preister Domestic well during the fifty-sixth and fifty-seventh quarters. Concentrations of 1,1-DCE and PCE were above the MCLs in the "Before" (pre-treatment) samples collected during both quarters. Results from the "After" (after treatment) sample collected during the fifty-sixth quarter indicated that 1,1-DCE exceeded the MCL. An "after treatment" sample was not collected during the fifty-seventh quarter. To address resident

concerns associated with breakthrough of VOCs in the primary filtration system installed at the Preister house, an additional filtration system was installed at the kitchen sink. Samples of the drinking water after the final filtration system at the sink have been collected on a biweekly basis from installation in October 2002 through March 2003. VOCs have not been detected in the post-treatment samples.

Inorganic analyses were also performed on samples collected from the Preister well ("Before" and "After" the primary filtration system) during both quarters. Metals and sulfate concentrations did not exceed MCLs or alternate off-property cleanup levels.

MONITORING PARAMETERS FOR HRC TREATMENT

DO, ORP, sulfate, sulfide and dissolved iron were measured for wells MW89-12 and MW89-15 (completed in the Sand & Gravel Aquifer) and MW89-13 and MW89-14 (completed in the Sand Channel) during the fifty-sixth and fifty-seventh quarters to monitor potential water chemistry changes resulting from the HRC treatment. The results are summarized in Table 5. Generally, the results for the fifty-sixth and fifty-seventh quarters do not indicate significant changes indicative of a change in the subsurface chemical environment. The decrease in DO measurements at MW89-12 observed in May 2002 and August 2002 appears to be rebounding to an oxygenated condition. The increases and decreases noted in DO, ORP and iron concentrations in the other wells is likely attributable to typical seasonal fluctuations in the Sand Channel and the upper Sand & Gravel Aquifer.

Based on the monitoring performed during the fifty-sixth and fifty-seventh quarters, there does not appear to be a measurable change in the aerobic/anaerobic conditions in the Sand Channel or the aquifer. The HRC injection was performed at the end of the irrigation season in 2001 to allow a longer residence time of the HRC in the soils beneath the Sand Channel. These soils are considered the primary residual source of chlorinated solvents at the site. Measurable changes in groundwater chemistry were not anticipated until the irrigation season resumed inducing the drainage of groundwater and HRC from the Sand Channel through the aquitard into the Sand & Gravel Aquifer. The volume of water removed from the aquifer during the 2002 irrigation season likely resulted in a significant amount of drainage of groundwater from the Sand Channel through the aquitard. Although the data to date do not clearly indicate a definitive change due to the HRC treatment, the stress on the aquifer during the 2002 irrigation season, has likely resulted in the downward migration of HRC through the aquitard as planned. Effects of the HRC treatment may be more apparent in the remainder of 2003. However, changes are not likely to be observed based on field parameters but by an increase in degradation products of the primary VOCs, PCE, 1,1-DCE, and 1,1,1-TCA.

ADDITIONAL FINDINGS

Additional wells not included in the required quarterly monitoring program were sampled for VOCs during the period between October 2002 and February 2003. The domestic wells sampled included the following: Doug Beller's Domestic, Ron Pfeifer's Domestic (house), Old Moravec well, Beller's Domestic (Before and After), Beller's Stock, Ben Pfeifer's House, Ed Luetkenhaus House, and the Preister's Irrigation well. Monitoring wells 89-10B and 89-11B, previously

removed from the monitoring program, were also sampled for VOCs. Sample results are summarized in Table 4.

VOCs were not detected at any of these wells with the exception of Beller's Domestic, Beller's Stock, Preister's Irrigation well, and MW89-11B. The VOCs detected were below associated MCLs with the exception of PCE at the Beller Domestic well, and 1,1-DCE and PCE at the Beller Stock well. The data collected from the Beller Domestic, Beller Stock well, and MW89-11B indicates that VOCs are currently present in the groundwater in this area and that some lateral dispersion is occurring northwest of MW92-3A and MW92-3B. Dispersion to the east of MW92-3A and MW92-3B was not indicated by the data collected at MW89-10B as VOCs were not detected at this well.

As discussed in the previous biannual report (URS, October 2002), peaks in concentrations at on-site wells MW89-12 and MW89-15 coincide with seasonal stress on the aquifer during the summer irrigation season (Figures 2 and 3). It is typical for concentrations to decrease and stabilize during the following winter. Concentrations at MW89-15 decreased consistently in November 2002 and February 2003 as expected. Concentrations at MW89-12 have remained relatively constant. This observation may be due in part to slow recovery of the aquifer in response to the intense 2002 irrigation season and a continuation of leakage from the residual pockets in the silty clays beneath the sand channel to the aquifer as a result of the drop in the aquifer water level. As shown on Figure 3, the overall concentrations of VOCs monitored at downgradient wells MW92-3A, MW92-3B, and Preister's Domestic well show an overall decrease or stabilized concentrations.

The concentrations of VOCs decrease from the residual source area (represented by MW89-15) to the Preister Domestic well (Figure 4).

CONCLUSIONS AND RECOMMENDATIONS

Substantial progress in aquifer restoration has been made since the cessation of interception well pumping in the mid 1990's (Figure 3). The limited areas of residual exceedance of cleanup criteria are intermittent defined along an axis from source area to the downgradient terminus. This terminus is controlled by three irrigation wells and monitored through sampling of monitoring wells MW92-3A, MW92-3B and the Preister domestic well.

The distribution of total residual organic compounds in the aquifer occurs in two areas near wells MW89-15, MW89-12 and OIW (source area wells) and at wells MW92-3A, MW92-3B and the Preister Domestic well (down gradient wells). With the cessation of irrigation well pumping for the winter, decreases in the residual concentrations of VOCs were observed at most wells. The additional data obtained from the Beller Domestic well, Beller Stock well, and MW89-11B indicates that lateral dispersion of the residuum is occurring to the northwest of MW92-3A and MW92-3B. Control of the ambient flow of groundwater and capture by interceptor well MW89-12 and irrigation wells along this axis continues as shown by the decreasing concentrations noted at the Priester Domestic well and stabilization at wells MW92-3A and MW92-3B.

As discussed in previous reports, insitu treatment using HRC injected into the soils above the aquifer where residual organics persist was initiated in September 2001. This action is intended to

"polish" the residual VOCs in these soils. Field parameters have not clearly indicated a change in subsurface chemistry. As the silty clay soils where residual chlorinated solvents remain are medium dense and plastic, it may be an extended time before the HRC treatment effects are clearly observed. As the aquifer is continuously recharged, including the sand channel, field measurements may not be the best indicator of the HRC effect. Instead, increases in degradation products like 1,2-DCE, 1,1-DCA, 1,2-DCA, and TCE accompanied with decreases in the parent constituents, 1,1-DCE, PCE, and 1,1,1-TCA may provide a better indication of the HRC treatment. Based on the quarterly data collected and the additional findings, URS recommends the following for the monitoring period from April 2003 to September 2003:

- Continue and maximize pumping of modified MW89-12 as an interceptor well
- Sample the Beller Stock well, Beller Domestic (Before treatment), MW89-11B, and MW89-10B during the fifty-ninth quarter (August 2003) to assess VOC concentration trends and residual areas
- Omit DO, ORP, sulfate, sulfide, and iron measurements conducted for HRC monitoring at wells MW89-12, MW89-13, MW89-14, and MW89-15

If you have any questions regarding this Enhanced Groundwater Remediation Progress Report, please do not hesitate to contact URS at your convenience.

Very truly yours,
URS CORPORATION

Karen L. Mixon
Task Manager

Roy W. Elliott
Vice President

Table 1
Summary of Pumping Volumes and pH
Fifty-Sixth and Fifty-Seventh Quarters
October 1, 2002 through March 31, 2003
Lindsay Manufacturing Company

	TIW		AOIW		OIW		MW 89-12		Total
	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Total Gal.	pH Range	Gallons
Monthly Summary									
October-02	0	NA	0	NA	0	NA	131,222	NA	131,222
November-02	0	NA	0	NA	0	NA	0	6.37	0
December-02	0	NA	0	NA	0	NA	0	NA	0
January-03	0	NA	0	NA	0	NA	0	NA	0
February-03	0	NA	0	NA	0	NA	0	5.70	0
March-03	0	NA	0	NA	0	NA	0	NA	0
56th Quarter									
October, November, December 2002	0	NA	0	NA	0	NA	131,222	NA	131,222
57th Quarter									
January, February, March 2003	0	NA	0	NA	0	NA	0	NA	0
56th and 57th Quarters	0	NA	0	NA	0	NA	131,222	NA	131,222

NA Not Applicable or Not Analyzed

Table 2
Summary of Wells Sampled and Analytical Plan
Fifty-Sixth Quarter through Fifty-Seventh Quarter
October 2002 through March 2003
Lindsay Manufacturing Company

Well ID	pH (lab) (EPA Method 150.1)	Volatile Organic Compounds (EPA Method 8260)	Total Zinc (CLP Method)	Sulfate (EPA Method 375.2)	Total Cadmium (CLP Method)	Total Chromium (CLP Method)	Total Iron (CLP Method)	Total Lead (CLP Method)
Samples Collected October 2002								
Preister's Drinking Water (10-14-02)		X						
Preister's Drinking Water (10-29-02)		X						
Preister's Stock		X						
Doug Beller's Domestic		X						
Ron Pfeifer's Domestic (House)		X						
Old Moravec well		X						
Samples Collected November 2002								
87-3	X	X	X	X	X	X	X	X
89-12		X	X				X	
89-13		X						
89-14	X	X	X	X	X	X	X	X
89-15	X	X	X	X	X	X	X	X
92-3A	X	X	X	X	X	X	X	X
92-3B	X	X	X	X	X	X	X	X
AOI Well		X						
OI Well		X						
Preister's Domestic (Before)	X	X	X	X	X	X	X	X
Preister's Domestic (After)	X	X	X	X	X	X	X	X
Preister's Drinking Water (11-12-02)		X						
Preister's Drinking Water (11-25-02)		X						
Beller's Domestic (Before)		X						
Beller's Domestic (After)		X						
Beller's Stock		X						
Samples Collected December 2002								
89-11B		X						
Preister's Drinking Water (12-09-02)		X						
Preister's Drinking Water (12-19-02)		X						
Preister's Drinking Water (12-30-02)		X						
Old Moravec Well		X						
Samples Collected January 2003								
Preister's Drinking Water (01-13-03)		X						
Preister's Drinking Water (Kitchen, 01-27-03)		X						
Preister's Basement (between filters, 01-27-03)		X						
Samples Collected February 2003								
87-3	X	X	X	X	X	X	X	X
89-10B		X						
89-11B		X						
89-12		X						
89-13		X						
89-14	X	X	X	X	X	X	X	X
89-15	X	X	X	X	X	X	X	X
AOI Well		X						
OI Well		X						
Preister's Irrigation		X						
Beller's Domestic (Before)		X						
Ed Luetkenhaus House		X						
Ben Pfeifer's House		X						
Ron Pfeifer's Domestic (House)		X						
92-3A		X						
92-3B		X						
Preister's Drinking Water (02-14-03)	X	X	X	X	X	X	X	X
Preister's Drinking Water (02-24-03)		X						
Preister's Domestic (Before)	X	X	X	X	X	X	X	X
Samples Collected March 2003								
Preister's Drinking Water (03-17-03)		X						
Preister's Domestic (Between Filter on RO unit, 3-17-03)		X						

Table 3
Summary of Analytical Results for Inorganic Compounds
Fifty-Second through Fifty-Seventh Quarters
November 2001 through March 2003
Lindsay Manufacturing Company

Well ID	Lab ID	Field Measurements				Total Metals (mg/L)					
		pH (field)	pH (lab)	Water Temperature (°C) (field)	Specific Conductivity (umhos/cm) (field)	Zinc	Sulfate	Cadmium	Chromium	Iron	Lead
Federal MCL				NS	NS	5.0[a]		0.005	0.05		0.05
Alternate Cleanup Level[b] - On Property		≥ 5.0	≥ 5.0	NE	NE	NE	500	NE	NE	10	NE
Alternate Cleanup Level[b] - Off Property		≥ 6.3	≥ 6.3	NE	NE	NE	400	NE	NE	1	NE
Historical Data:											
Old Lindsay Public Supply Well (Sampled January 1977)		NA	7.4	NA	NA	NA	NA	NA	NA	NA	NA
Old Lindsay Public Supply Well (Sampled 01/28/83)		NA	7.2	NA	NA	NA	NA	NA	NA	NA	NA
15261 (Sampled 01/28/83)		NA	7.0	NA	NA	0.11	3.1	U	U	NA	U
15262 (Sampled 01/28/83)		NA	7.1	NA	NA	0.11	14.0	U	U	NA	U
Samples Collected November 2001											
87-3	01-19700-DU60D	6.35	6.6 J	11.5	949	0.219	34	0.002 U	0.009	0.08	0.001 U
89-14	01-19697-DU60A	5.88	6.3 J	11.6	660	10.1	170	0.003	0.027	3.31	0.005
89-15	01-19698-DU60B	5.02	4.8 J	12.6	2010	127	1100	0.007	0.01 U	33.3	0.001 U
92-3A	01-19786-DU75A	6.75	6.9 J	11.7	569	0.030	26	0.002 U	0.102	3.63	0.002
92-3B	01-19787-DU75B	6.41	6.5 J	12.2	724	0.006 U	170	0.002 U	0.087	1.68	0.001 U
Preister's Domestic (Before)	01-19701-DU60E	6.84	7.0 J	16.1	949	0.046	130	0.002 U	0.005 U	0.05 U	0.001 U
Preister's Domestic (After)	01-19702-DU60F	6.98	7.1 J	16.5	951	0.019	130	0.002 U	0.005 U	0.05 U	0.001 U
Samples Collected February 2002											
87-3	02-1446-EB74D	6.60	6.7 J	12.2	766	0.136	25	0.002 U	0.012	0.11	0.001 U
89-14	02-1443-EB74A	5.82	5.8 J	10.5	690	16.1	360	0.004	0.019	2.42	0.003
89-15	02-1444-EB74B	6.18	6.2 J	10.5	1430	71.5	600	0.002	0.008	1.84	0.001 U
Preister's Domestic (Before)	02-1502-EB89A	6.63	7.0 J	9.0	981	0.009	120	0.002 U	0.005 U	0.05 U	0.001
Preister's Domestic (After)	02-1503-EB89B	6.80	7.1 J	10.1	970	0.008	140	0.002 U	0.005 U	0.05 U	0.001 U
Samples Collected May 2002											
87-3	02-6069-EJ19F	6.61	6.7 J	10.4	785	0.107	25	0.002 U	0.012 J	0.11	0.001 U
89-14	02-6066-EJ19C	5.61	5.2 J	14.2	1110	17.6	280	0.006	0.006 J	2.21	0.002 U
89-15	02-6067-EJ19D	6.58	6.5 J	13.9	1210	43.8	320	0.002	0.005 J	0.36	0.001 U
92-3A	02-6315-EJ54A	6.77	8.0 J	12.2	459	0.016	19 J	0.002 U	0.190 J	1.92	0.001 U
92-3B	02-6316-EJ54B	6.47	6.4 J	12.0	558	0.008	150	0.002 U	0.066 J	0.54	0.001 U
AOI Well	02-6070-EJ19G	6.39	6.4 J	13.8	381	2.05	46	0.002 U	0.005 UJ	0.14	0.001 U
OI Well	02-6068-EJ19E	6.67	6.7 J	11.9	726	12.5	210	0.002 U	0.005 UJ	0.25	0.001 U
Preister's Domestic (Before)	02-6317-EJ54C	6.92	6.9 J	13.8	818	0.020	170	0.002 U	0.011 J	0.05 U	0.004
Preister's Domestic (After)	02-6318-EJ54D	6.92	6.9 J	15.7	860	0.006	180	0.002 U	0.005 UJ	0.05 U	0.001 U
Samples Collected August 2002											
87-3	02-10830-EQ82F	6.44	6.79 J	13.2	722	1.22	34	0.002 U	0.013	0.62	0.001 U
89-12	02 10825-EQ82A	6.25	NA	14.6	820	1.66	299	NA	NA	0.05 U	NA
89-13	02-10826-EQ82B	7.18	NA	14.1	513	NA	30	NA	NA	NA	NA
89-14	02-10827-EQ82C	6.26	6.26 J	14.1	858	10.5	200	0.004	0.005 U	1.16	0.001 U
89-15	02-10828-EQ82D	5.29	5.32 J	14.0	1330	71.2	580	0.007	0.006	19.1	0.001 U
Preister's Domestic (Before)	02-10832-EQ82H	6.52	7.20 J	15.5	820	0.009	87	0.002 U	0.005 U	0.05 U	0.001 U
Preister's Domestic (After)	02-10833-EQ82I	6.60	7.21 J	14.7	834	0.007	88	0.002 U	0.005 U	0.05 U	0.001 U
Samples Collected November 2002											
87-3	02-16321-EY32I	6.58	6.78	11.6	920	0.349	31	0.002 U	0.012	0.21	0.001 U
89-12	02-16313-EY32A	6.37	NA	12.9	1172	1.96	NA	NA	NA	0.07	NA
89-14	02-16315-EY32C	6.51	5.87 J	11.3	754	7.08	150	0.003	0.007	1.08	0.001
89-15	02-16316-EY32D	5.63	5.70 J	11.5	1920	94.8	730	0.007	0.01 U	19.2	0.001 U
92-3A	02-16403-EY52A	6.69	6.92 J	11.4	497	0.007	17	0.002 U	0.085	1.98	0.001 U
92-3B	02-16404-EY52B	6.50	6.53 J	11	651	0.009	150	0.002 U	0.156	2.13	0.001 U
Preister's Domestic (Before)	02-16407-EY52E	7.07	7.02 J	13.6	749	0.006	87	0.002 U	0.005 U	0.05 U	0.001
Preister's Domestic (After)	02-16408-EY52F	7.10	7.12 J	13.8	773	0.006 U	88	0.002 U	0.005 U	0.05 U	0.001

Table 3
Summary of Analytical Results for Inorganic Compounds
Fifty-Second through Fifty-Seventh Quarters
November 2001 through March 2003
Lindsay Manufacturing Company

Well ID	Lab ID	Field Measurements				Total Metals (mg/L)					
		pH (field)	pH (lab)	Water Temperature (°C) (field)	Specific Conductivity (umhos/cm) (field)	Zinc	Sulfate	Cadmium	Chromium	Iron	Lead
Federal MCL				NS	NS	5.0*		0.005	0.05		0.05
Alternate Cleanup Level[1]- On Property		≥ 5.0	≥ 5.0	NE	NE	NE	500	NE	NE	10	NE
Alternate Cleanup Level[1]- Off Property		≥ 6.3	≥ 6.3	NE	NE	NE	400	NE	NE	1	NE
Historical Data:											
Old Lindsay Public Supply Well (Sampled January 1977)		NA	7.4	NA	NA	NA	NA	NA	NA	NA	NA
Old Lindsay Public Supply Well (Sampled 01/28/83)		NA	7.2	NA	NA	NA	NA	NA	NA	NA	NA
15261 (Sampled 01/28/83)		NA	7.0	NA	NA	0.11	3.1	U	U	NA	U
15262 (Sampled 01/28/83)		NA	7.1	NA	NA	0.11	14.0	U	U	NA	U
Samples Collected February 2003											
87-3	03-1565-FF64I	6.59	6.85	12.4	982	0.259	32	0.002 U	0.008	0.06	0.001 U
89-14	03-1562-FF64F	5.71	5.42 J	9.8	594	6.74	160	0.002	0.005 U	0.87	0.001
89-15	03-1563-FF64G	5.86	6.31 J	10.8	1530	62.4	390	0.005	0.005 U	3.41	0.002
Preiser's Domestic (Before)	03-1787-PG00C	6.75	7.12 J	12.9	827	0.013	100	0.002 U	0.005 U	0.05 U	0.002
Preiser's Drinking Water (2-14-03)	03-1788-PG00D	NA	5.84 J	NA	NA	0.008	2.5 U	0.002 U	0.005 U	0.05 U	0.001 U

Notes:
* EPA secondary MCLs
NA = Not Analyzed or Not Available
NS = No Standard
NE = Not Established
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected
Bold font indicates result reported is above or equal to the MCL (zinc, cadmium, chromium, or lead) or the applicable alternate cleanup level (pH, sulfate, iron).
[1] Reference letter from State of Nebraska to Lindsay Manufacturing Company dated 12/14/00

Table 4
Summary of Analytical Results for Organic Compounds
Fifty-Second through Fifty-Seventh Quarters
November 2001 through March 2003
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C°) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
EPA MCL				NS	NS	7	NS	170	5	200	5	5	-
Alternate Cleanup Level [3] - On Property		≥ 5.0	≥ 5.0	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Alternate Cleanup Level [4] - Off Property		≥ 6.3	≥ 6.3	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Samples Collected November 2001													
87-3	01-19700-DU60D	6.35	6.6 J	11.5	949	19	5 U	5 U	5 U	30	5 U	5	54
89-12	01-19704-DU60H	6.47	NA	13.1	920	54	29	6	5 U	120	5 U	170	379
89-13	01-19705-DU60I	6.88	NA	11.3	456	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
89-14	01-19697-DU60A	5.88	6.3 J	11.6	660	5 U	5 U	5 U	5 U	8	5 U	5	13
89-15	01-19698-DU60B	5.02	4.8 J	12.6	2010	140	20	13	5 U	200	5 U	110	483
92-3A	01-19786-DU75A	6.75	6.9 J	11.7	569	12	5 U	5 U	5 U	100	5 U	42	154
92-3B	01-19787-DU75B	6.41	6.5 J	12.2	724	5 U	5 U	5 U	5 U	16	5 U	8	24
AOI Well	01-19706-DU60J	6.27	NA	13.9	463	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	01-19699-DU60C	6.44	NA	12.1	929	28	5 U	5 U	5 U	35	5 U	23	86
Preister's Domestic (Before)	01-19701-DU60E	6.84	7.0 J	16.1	949	38 J	4.7	2.2	0.3 J	77 J	0.5	37 J	159
Preister's Domestic (After)	01-19702-DU60F	6.98	7.1 J	16.5	951	1.2	1.0	0.2 U	0.2 U	5.8	0.2 U	0.2 U	8
Samples Collected February 2002													
87-3	02-1446-EB74D	6.60	6.7 J	12.2	766	22	5 U	5 U	5 U	30	5 U	6	58
89-12	02-1450-EB74H	6.43	NA	11.0	974	24	5 U	5 U	5 U	23	5 U	70	117
89-13	02-1451-EB74I	7.22	NA	9.7	528	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
89-14	02-1443-EB74A	5.82	5.8 J	10.5	690	5 U	5 U	5 U	5 U	5 U	5 U	6	6
89-15	02-1444-EB74B	6.18	6.2 J	10.5	1430	110	7	5 U	5 U	130	5 U	93	340
92-3A	02-1504-EB89C	6.79	NA	10.6	568	16	5 U	5 U	5 U	110	5 U	48	174
92-3B	02-1505-EB89D	6.45	NA	11.6	670	5 U	5 U	5 U	5 U	10	5 U	6	16
AOI Well	02-1448-EB74F	6.28	NA	13.5	379	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	02-1445-EB74C	6.73	NA	11.3	642	20	5 U	5 U	5 U	9	5 U	32	61
Preister's Domestic (Before)	02-1502-EB89A	6.63	7.0 J	9.0	981	51	5.2	2.4	1.0 U	94	1.0 U	49	202
Preister's Domestic (After)	02-1503-EB89B	6.80	7.1 J	10.1	970	1.1	0.6	0.2 U	0.2 U	3.6	0.2 U	0.2 U	5.3
Samples Collected March 2002													
89-12	02-3391-EB94A	6.35	NA	14.0	967	44	16	5 U	5 U	70	5 U	150	280

Table 4
Summary of Analytical Results for Organic Compounds
Fifty-Second through Fifty-Seventh Quarters
November 2001 through March 2003
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C°) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
EPA MCL				NS	NS	7	NS	170	5	200	5	5	-
Alternate Cleanup Level [1] - On Property		≥ 5.0	≥ 5.0	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Alternate Cleanup Level [1] - Off Property		≥ 6.3	≥ 6.3	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Samples Collected May 2002													
87-3	02-6069-EJ19F	6.61	6.7 J	10.4	785	14	5 U	5 U	5 U	22	5 U	5	41
89-12	02-6064-EJ19A	6.67	NA	12.2	1090	18	5 U	5 U	5 U	10	5 U	32	60
89-13	02-6065-EJ19B	6.73	NA	11.6	536	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
89-14	02-6066-EJ19C	5.61	5.2 J	14.2	1110	5 U	5 U	5 U	5 U	5	5 U	7	12
89-15	02-6067-EJ19D	6.58	6.5 J	13.9	1210	67	5 U	5 U	5 U	89	5 U	56	212
92-3A	02-6315-EJ54A	6.77	8.0 J	12.2	459	5 U	5 U	5 U	5 U	97	5 U	42	139
92-3B	02-6316-EJ54B	6.47	6.4 J	12.0	558	5 U	5 U	5 U	5 U	11	5 U	6	17
AOI Well	02-0670-EJ19G	6.39	6.4 J	13.8	381	5 U	5 U	5 U	5 U	5 U	5 U	5 U	ND
OI Well	02-6068-EJ19E	6.67	6.7 J	11.9	726	18	5 U	5 U	5 U	7	5 U	33	58
Preister's Domestic (Before)	02-6317-EJ54C	6.92	6.9 J	13.8	818	80	7.2	3.1	1.0 U	130	1.0 U	63	283
Preister's Domestic (After) [2]	02-6318-EJ54D	6.92	6.9 J	15.7	860	1.9	1.2	0.2 U	0.2 U	9.2	0.2 U	0.2 U	12
Samples Collected June 2002													
89-12	02-8175-EM04A	6.83	NA	13.5	949	19 J	5 UJ	5 UJ	5 UJ	11 J	5 UJ	28 J	58
Samples Collected August 2002													
87-3	02-10830-EQ82F	6.44	6.79 J	13.2	722	12 J	5 UJ	5 UJ	5 UJ	13 J	5 UJ	5 UJ	25
89-12	02-10825-EQ82A	6.25	NA	14.6	820	78 J	46 J	5 UJ	5 UJ	84 J	5 UJ	260 J	468
89-13	02-10826-EQ82B	7.18	NA	14.1	513	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	ND
89-14	02-10827-EQ82C	6.26	6.26 J	14.1	858	12 J	5 UJ	5 UJ	5 UJ	19 J	5 UJ	9 J	40
89-15	02-10828-EQ82D	5.29	5.32 J	14.0	1330	180 J	54 J	50 J	5 UJ	290 J	5 UJ	170 J	744
92-3A	02-11036-EQ96A	6.58	NA	12.0	547	10	5 U	5 U	5 U	77 J	5 U	23	110
92-3B	02-11037-EQ96B	5.76	NA	12.9	711	5 U	5 U	5 U	5 U	12 J	5 U	5 U	12
AOI Well	02-10831-EQ82G	6.09	NA	12.9	475	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	5 UJ	ND
OI Well	02-10829-EQ82E	6.32	NA	11.6	1207	120 J	45 J	16 J	5 UJ	290 J	5 UJ	110 J	581
Preister's Domestic (Before)	02-10832-EQ82H	6.52	7.20 J	15.5	820	30 J	3.0 J	3 UJ	3 UJ	54 J	3 UJ	30 J	117
Preister's Domestic (After) [2]	02-10833-EQ82I	6.60	7.21 J	14.7	834	31 J	4.3 J	1.0 J	0.2 UJ	69 J	0.2 UJ	0.2 UJ	105
Samples Collected September 2002													
Preister's Domestic (Before)	02-14197-EV12A	NA	NA	NA	NA	29	2.8	1.0	1.0 U	53	1.0 U	24	110
Preister's Domestic (After)	02-14198-EV12B	NA	NA	NA	NA	26	3.4	1.0 U	1.0 U	49	1.0 U	1.0 U	78
Beller's Domestic (After)	02-14199-EV12C	NA	NA	NA	NA	1.4	1 U	1 U	1 U	1.8	1 U	4.2	7.4
Beller's Stock Well	02-14200-EV12D	NA	NA	NA	NA	21	6.9	1 U	1 U	29	1 U	65	122

Table 4
Summary of Analytical Results for Organic Compounds
Fifty-Second through Fifty-Seventh Quarters
November 2001 through March 2003
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C^{O}) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
EPA MCL				NS	NS	7	NS	170	5	200	5	5	
Alternate Cleanup Level [1] - On Property		≥ 5.0	≥ 5.0	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Alternate Cleanup Level [1] - Off Property		≥ 6.3	≥ 6.3	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Samples Collected October 2002													
Preister's Drinking Water (10-14-02)	02-15259-EW83A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Preister's Drinking Water (10-29-02)	02-16080-EX88A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Preister's Stock [3]	02-14785-EV91B	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Doug Beller's Domestic	02-14784-EV91A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Ron Pfeifer's Domestic (House)	02-15917-EX65A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Old Moravec well	02-15918-EX65B	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Samples Collected November 2002													
87-3	02-16321-EY32I	6.58	6.78	11.6	920	17	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	8	25
89-12	02-16313-EY32A	6.37	NA	12.9	1172	74	33	7	5.0 U	110	5.0 U	280	504
89-13	02-16314-EY32B	7.29	NA	11.4	583	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	ND
89-14	02-16315-EY32C	6.51	5.87 J	11.3	754	8	5.0 U	5.0 U	5.0 U	15	5.0 U	11	34
89-15	02-16316-EY32D	5.63	5.70 J	11.5	1920	130	36	40	5.0 U	180	5.0 U	110	496
92-3A [4]	02-16403-EY52A	6.69	6.92 J	11.4	497	6	5.0 U	5.0 U	5.0 U	63	5.0 U	28	97
92-3B	02-16404-EY52B	6.50	6.53 J	11	651	5.0 U	5.0 U	5.0 U	5.0 U	9	5.0 U	6	15
AOI Well	02-16322-EY32J	6.18	NA	13	514	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	ND
OI Well	02-16317-EY32E	6.42	NA	12.8	850	35	8	5.0 U	5.0 U	59	5.0 U	35	137
Preister's Domestic (Before)	02-16407-EY52E	7.07	7.02 J	13.6	749	27	2.9	1.5	1.0 U	30	1.0 U	28	109
Preister's Domestic (After)	02-16408-EY52F	7.10	7.12 J	13.8	773	16	2.3	1.0 U	1.0 U	29	1.0 U	1.0 U	47
Preister's Drinking Water (11-12-02)	02-16661-EZ00A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Preister's Drinking Water (11-25-02)	02-17375-FA14A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Beller's Domestic (Before)	02-16318-EY32F	6.69	NA	14.8	906	2.2	1.3	1.0 U	1.0 U	2.8	1.0 U	1.2	7.5
Beller's Domestic (After)	02-16319-EY32G	6.74	NA	14	902	1.8	1.0	1.0 U	1.0 U	1.0 U	1.0 U	7	9.8
Beller's Stock	02-16320-EY32H	6.75	NA	10.9	825	20	7.8	1.0 U	1.0 U	30	1.0 U	86	144
Samples Collected December 2002													
Preister's Drinking Water (12-09-02)	02-18063-FB12A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Preister's Drinking Water (12-19-02)	02-19062-FC51B	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Preister's Drinking Water (12-30-02)	02-19323-FC83A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Old Moravec Well	02-19061-FC51A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
89-11B	02-19063-FC51C	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.4	1.4
Samples Collected January 2003													
Preister's Drinking Water (01-13-03)	03-361-FD57A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Preister's Drinking Water (Kitchen, 01-27-03)	03-793-FE41A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Preister's Basement (between filters, 01-27-03)	03-794-FE41B	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND

Table 4
Summary of Analytical Results for Organic Compounds
Fifty-Second through Fifty-Seventh Quarters
November 2001 through March 2003
Lindsay Manufacturing Company

Well ID	Lab ID	pH (field)	pH (lab)	Water Temperature (C°) (field)	Specific Conductivity (umhos/cm) (field)	1,1-DCE (µg/L)	1,1-DCA (µg/L)	1,2-DCE (µg/L)	1,2-DCA (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	PCE (µg/L)	Total Organics (µg/L)
EPA MCL				NS	NS	7	NS	170	5	200	5	5	-
Alternate Cleanup Level [1] - On Property		≥ 5.0	≥ 5.0	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Alternate Cleanup Level [1] - Off Property		≥ 6.3	≥ 6.3	NE	NE	NE	NE	NE	NE	NE	NE	NE	-
Samples Collected February 2003													
87-3	03-1565-FF64I	6.59	6.85	12.4	982	27	5.0 U	5.0 U	5.0 U	29	5.0 U	8	64
89-10B	03-1559-FF64C	6.91	NA	12.1	474	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	ND
89-11B	03-1558-FF64B	6.85	NA	10.4	654	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	ND
89-12	03-1560-FF64D	5.70	NA	11.5	1270	42	15	5.0 U	5.0 U	67	5	400	529
89-13	03-1561-FF64E	6.57	NA	10.4	605	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	ND
89-14	03-1562-FF64F	5.71	5.42 J	9.8	594	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	6	6
89-15	03-1563-FF64G	5.86	6.31 J	10.8	1530	46	5.0 U	5.0 U	5.0 U	51	5.0 U	38	135
92-3A	03-1785-FG00A	6.68	NA	10.6	505	5	5.0 U	5.0 U	5.0 U	65	5.0 U	29	99
92-3B	03-1786-FG00B	6.34	NA	11.0	576	5.0 U	5.0 U	5.0 U	5.0 U	5	5.0 U	5.0 U	5
OI Well	03-1564-FF64H	6.40	NA	13.0	805	13	5.0 U	5.0 U	5.0 U	11	5.0 U	16	40
AOI Well	03-1567-FF64K	6.10	NA	12.4	521	5.0 U	5.0 U	5.0 U	5.0 U	6	5.0 U	5.0 U	6
Beller's Domestic (Before)	03-1557-FF64A	6.69	NA	13.4	746	2.3	1.4	1.0 U	1.0 U	3.0	1.0 U	9.3	16
Preister's Irrigation	03-1719-FF91A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.6	1.0 U	3.4	5
Preister's Drinking Water (02-14-03)	03-1788-FG00D	NA	5.84 J	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Preister's Drinking Water (02-24-03)	03-2050-FG52A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Preister's Domestic (Before)	03-1787-FG00C	6.75	7.12 J	12.9	827	24	2.8	1.4	1.0 U	47	1.0 U	27	102
Ben Pfeifer's House	03-1720-FF91B	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Ed Luetkenhaus House	03-1721-FF91C	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Ron Pfeifer's Domestic (House)	03-1722-FF91D	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Samples Collected March 2003													
Preister's Drinking Water (03-17-03)	03-2853-FH83A	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND
Preister's Domestic (Between filter on RO unit, 03-17-03)	03-2854-FH83B	NA	NA	NA	NA	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	ND

Notes:
NA = Not Analyzed or Not Available
ND = Not Detected
NS = No Standard
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
Bold font indicates result reported is above or equal to the MCL.

[1] Reference letter from State of Nebraska to Lindsay Manufacturing Company dated 12/14/00

[2] Methylene Chloride (0.4 ug/L) and acetone (1.2 ug/L) were reported in the May 2002 sample and acetone (2.6 ug/L) in the August 2002 sample. These compounds are believed to be the result of laboratory contamination and not representative of the sample.

[3] Carbon tetrachloride was detected at 2.4 ug/L. The MCL is 5 ug/L.

[4] A field duplicate was collected at 92-3A. 1,1-DCE reported in the table is from the duplicate analysis. The concentration in the parent sample was <5 ug/L.

1,1-DCE = 1,1-Dichloroethene
1,1-DCA = 1,1-Dichloroethane
1,2-DCE = total of cis-1,2-dichloroethene and trans-1,2-dichloroethene
1,2-DCA = 1,2-Dichloroethane
1,1,1-TCA = 1,1,1-Trichloroethane
TCE = Trichloroethene
PCE = Tetrachloroethene

Table 5
Summary of Analytical Results for HRC Injection Monitoring Parameters
August 2001 through February 2003
Lindsay Manufacturing Company

Well ID	Field Measurements						Laboratory Analyses							
	pH (field)	pH (lab)	Water Temperature (°C) (field)	Specific Conductivity (umhos/cm) (field)	Dissolved Oxygen (mg/l)	Oxidation/Reduction Potential (mv)	Sulfate (mg/l)	Sulfide (mg/l)	Dissolved Iron (mg/l)	Total Iron (mg/l)	Nitrate as N (mg/l)	Nitrite as N (mg/l)	Orthophosphate as P (ug/l)	Aerobic Plate Count (cfu/ml)
Samples Collected August 2001 (information to complete design)														
89-12	6.06	NA	14.2	1,390	NA	NA	354	NA	NA	NA	13.3	0.02 UJ	0.34	90
89-13	7.43	NA	12.8	578	NA	NA	32	NA	NA	NA	4.7	0.02 UJ	0.34	< 1
89-14	6.07	6.2 J	14.0	969	9.59	128	358/240 *	NA	NA	5.66	4.4	0.05 J	0.05 U	5,700
89-15	4.92	4.6 J	15.1	1,998	8.73	207	1173/1200 *	NA	NA	56.4	12.7	0.03 J	0.05 U	< 1
Samples Collected November 2001														
89-12	6.47	NA	13.1	920	10.1	262	253	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-13	6.88	NA	11.3	456	10.5	242	34	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-14	5.88	6.3 J	11.6	660	13.8	164	170	1.0 U	0.61	3.31	NA	NA	NA	NA
89-15	5.02	4.8 J	12.6	2,010	4.05	181	1100	1.0 U	38.8	33.3	NA	NA	NA	NA
Samples Collected February 2002														
89-12	6.43	NA	11.0	974	NA	225	170	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-13	7.22	NA	9.7	528	11	108	37	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-14	5.82	5.8 J	10.5	690	9.89	172	360	1.0 U	0.01 U	2.42	NA	NA	NA	NA
89-15	6.18	6.2 J	10.5	1,430	6.93	137	600	1.0 U	0.01 U	1.84	NA	NA	NA	NA
Samples Collected May 2002														
89-12	6.67	NA	12.2	1090	2.38	263	122	2.0 U	0.01 U	NA	NA	NA	NA	NA
89-13	6.73	NA	11.6	536	10.61	103	35	2.0 U	0.01 U	NA	NA	NA	NA	NA
89-14	5.61	5.2 J	14.2	1110	10.54	145	280	2.0 U	1.18	2.21	NA	NA	NA	NA
89-15	6.58	6.5 J	13.9	1210	7.06	124	320	2.0 U	0.01 U	0.36	NA	NA	NA	NA
Samples Collected August 2002														
89-12	6.25	NA	14.6	820	5.2	192	299	1.0 U	0.01 U	0.05 U	NA	NA	NA	NA
89-13	7.18	NA	14.1	513	11.75	97	30	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-14	6.26	6.26 J	14.1	858	8.65	65	200	1.0 U	0.37	1.16	NA	NA	NA	NA
89-15	5.29	5.32 J	14.0	1330	8.01	150	580	1.0 U	15	19.1	NA	NA	NA	NA
Samples Collected November 2002														
89-12	6.37	NA	12.9	1172	1.3	290	481	1.0 U	0.01 U	0.07	NA	NA	NA	NA
89-13	7.29	NA	11.4	583	12.15	148	32	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-14	6.51	5.87 J	11.3	754	11.78	167	150	1.0 U	0.01 U	1.08	NA	NA	NA	NA
89-15	5.63	5.70 J	11.5	1920	2.54	209	730	1.0 U	19.5	19.2	NA	NA	NA	NA
Samples Collected February 2003														
89-12	5.70	NA	11.5	1270	6.14	113	263	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-13	6.57	NA	10.4	605	13.85	117	31	1.0 U	0.01 U	NA	NA	NA	NA	NA
89-14	5.71	5.42 J	9.8	594	11.93	118	160	1.0 U	0.39	0.87	NA	NA	NA	NA
89-15	5.86	6.31 J	10.8	1530	10.66	104	390	1.0 U	0.88	3.41	NA	NA	NA	NA

Notes:
NA = Not Analyzed or Not Available
J = Indicates that value is an estimate either because quality control criteria were not met, or because the value was below the quantitation limit.
U = Indicates that the compound was analyzed for, but not detected.
* Samples were submitted for this test to Midwest Laboratories, Inc. in Omaha, NB and Analytical Resources, Inc. in Seattle, WA